Serie documentos de trabajo

AN ANALYSIS OF DIRECT TAXATION ON MEXICAN TAXPAYERS: A MICROSIMULATIONS APPROACH

Álvaro Baillet

DOCUMENTO DE TRABAJO

Núm. VIII - 1988

THE MEXICAN FISCAL SYSTEM

AN ANALYSIS OF DIRECT TAXATION ON MEXICAN TAXPAYERS: A MICROSIMULATIONS APPROACH

Alvaro Baillet
Centro de Estudios Económicos
El Colegio de México
December, 1986

Many thanks for discussions, comments and suggestions, at different stages of this work, to R. Aguirre, E. Ahmad, D. Coady, A. Fernández, G. Flores, A. García Rocha, L. Illanes, J. M. Pérez Porrua, J. Seade and N. Stern, and to Ma. Isabel Gómez for computing assistance. All remaining errors are mine.
Preliminary draft please do not quote. Comments welcome.

1. Introduction

The effects of changes in the tax structure of an economy on economic welfare, on the degree of progressivity of the system and on the level of revenue, has very often been of central concern to policy makers. In Mexico, with chronic public deficits and a distribution of income amongst the worst in Latin America, the tax system plays a key role in raising revenue and redistributing income. In this paper we analyse the changes in personal income taxes' incidence and in government revenue that take place when tax reforms occur, that is, when modifications are made to direct taxes. The focus of this work is only on personal income taxes, indirect taxation not being dealt with.

In order to analyse tax policy changes, a numerical model based on a microdata base is used to simulate alternative fiscal policies. The model is based on the 1977 income survey and the Income Tax Law for that year.

Although econometric work has a long tradition in economic research, the use of computerized numerical models for economic simulation is a relatively recent addition to the field. In tax policy analysis, in particular, we find two streams. The first one is that of computable general equilibrium models (CGEM) which analyse the effect of tax (and other variables) changes on the economy within a general equilibrium context. These models simulate numerically the behaviour of an economy, as represented by a set of equations. They usually work on a comparative basis, comparing two "equilibria", the basic one (the base solution), and the one that is simulated. As such, these models cannot incorporate detailed microdata sets of income and expenditure surveys, or tax revenue files, on a highly disaggregated basis[1].

1. See. T.N. Shoven, and J. Whalley, (1984), for an excellent survey of CGEM in the fields of taxation and international trade.

The second stream of models is characterised by its ability to carry out microsimulations at a very disaggregated level, only limited in fact by the available data. Some of these models introduce behavioural responses of the agents following the tax change, while others perform the simulations assuming no responses, just by comparing the situation before and after the policy change. The way in which most of these models work is quite similar. Having set up the data base, a numerical model which "replicates" the current tax laws is used to simulate changes in the tax system, showing the results of this on families, individuals, and revenue. The families analysed can be defined according to purely economic and/or sociodemographic characteristics, as well as by the type of problem being studied. The results are then compared to the base period in order to draw the relevant conclusions.

This paper follows the second streams of models, represented, among others, by work on the United States and the United Kingdom by Feldstein and Frisch (1977), Feldstein (1983), and Atkinson, King and Sutherland (1983). Some of these works assume behavioural responses on the part of households when tax changes occur; we assume no such responses induced by tax reforms.

1.1 The Problem.

Changes in taxation have two types of effects on the economy: Macroeconomic effects on the level of output, employment, prices and growth, and microeconomic effects with allocational and distributional consequences on individuals, families and firms.

In this paper we are concerned with the microeconomic aspects of the problem, and with the welfare effects of a tax reform on individuals. Since the Income Tax Law (ITL) in Mexico defines the individual as the basic taxable unit--

(TU), the principal idea of this work will be illustrated by defining a function characterizing one individual (denoted by the superscript h) in terms of its total tax liability, before a policy change occurs:

$$T^h = f(Y_t^h(\bar{Y}_i^h);\ \bar{S}_j^h\ ;\ t_k^h) \qquad (1.1)$$

where,

h	=	1,....,H.	Number of taxable Units
i	=	1,....,N.	Types of income considered
j	=	1,....,J.	Socio-demographic characteristics of the individual
k	=	1,....,K.	Number of tax parameters faced by the individual
t	=	1,....T.	Number of tax brackets in the tax schedule

T^h = Total tax liability of individual h

Y_t^h = Total taxable income

$\bar{Y}_i^h$ = Types of gross income accruing to the individual

$\bar{S}_j^h$ = Set of socio-demographic characteristics of the TU

t_k^h = Tax rates and related parameters

Keeping the socio-demographic characteristics of the taxable unit fixed, its tax liability becomes a function only of taxable income, Y_t^h, and of the tax parameters. The latter are the marginal tax rates, the tax on lower limit, and the lower and upper limits of the bracket considered, according to the income tax schedule[2]. Changes in tax liabilities and therefore on economic welfare, may come through a variation in any of the parameters entering the function, namely, taxable income, itself a function of gross income,

---

2. See appendix B for a description of the tax schedule.

and the tax parameters. By assumption, gross income is kept fixed, so that an increase in taxation means a reduction in disposable income of the individual.

Suppose now, that a tax reform takes place via a modification in the vector t^h_k, eg, an increase in marginal rates. Since gross income is kept unchanged, the welfare of the taxable unit will go down and its new position can be defined by another function in terms of the increased tax liability, of the changes in the taxable income vector and of its position relative to other individuals:

$$T'^h = f(Y'^h_t(\bar{Y}^h_i);\ \bar{S}^h_j\ ;\ t'^h_k) \qquad (1.2)$$

Having determined the new tax liability and taxable income vector, T'^h and Y'^h_t, and knowing the rest of the parameters defining the taxable unit, we can compare its new position relative to other TU's individually or by homogeneous groups, using different criteria. We have chosen the effective rate of taxation (ERT) for this purpose and grouped the population by taxable income levels. Although the results are presented in terms of tax incidence of the reform, special emphasis has been put in the micro analysis and in who gains and who loses because of such policy.

There are basically two types of questions that can be answered within this simple comparative statics framework. The first type deals with distributional issues, ie, with the effect of changes in any of the tax parameters on tax payments and consequently on net income, in symbols, $\partial T^h/\partial t^h_k$. In general, any change in the tax parameters will have an effect on the distribution of income, under the assumption of constant gross income.

The second type of questions deals with economic efficiency in the sense of tax policy changes inducing or modifying

the allocation of resources, and affecting certain decisions of the taxable unit such as the supply of labour, the level of savings and consumption, etc. In this case, we are interested in the effect that the marginal rates would have on such allocation and personal decisions. By definition,

$$\frac{\partial T^h}{\partial y_t^h} = m_t \qquad \forall\, t \qquad (1.3)$$

that is, the change in tax liability (government revenue) which follows a (small) change in taxable income is given by the marginal rate faced by the TU. If, for example, the marginal rates are thought to be very high by the economic agents, the marginal supply of labour of such agents will not be offered, and instead its leisure will increase. Similarly, if interest income is taxed very heavily, people's savings could be discouraged and the money taken somewhere else.

The organization of the paper is as follows. Section 2 presents an overall view of the Mexican tax system and describes the relevant parts of the Income Tax Law. The data base is discussed in section 3, while section 4 analyses the results in the year of reference and the simulations performed; section 5 concludes.

2. An Overview of the Tax System in Mexico

This section aims at showing the principal characteristics of the personal income tax in Mexico, in the general context of the tax system. It also discusses those parts of the Income Tax Law relevant for this study, without trying to be an exhaustive exposition of the subject.

The income tax was first introduced in 1921, at the end of the Mexican revolution. This law was structured in four "schedules", with rates from 1% to 4%, and remained with this type of structure throughout many subsequent changes until 1953. In 1964, The Income Tax Law was totally modified, disappearing the organisation in schedules in favour of a simpler and more comprehensive structure, which divided taxpayers into two broad categories, namely, persons and enterprises. This is the prevailing structure in the year of study, 1977, and in the following years.

The Income Tax Law is organised in five titles. Of particular importance for this work is title III, about income taxation of individuals. In this title are set out the laws regulating the payment of taxes on personal income from work remunerations and capital, as well as the corresponding tax schedules and the legislation concerning tax payments on global income (accumulated income). As this is the legal framework that was used for the data base and for the incidence simulations performed, we shall briefly discuss its main characteristics in section 2.2, after a general description of the tax system.

2.1 Structural Characteristics of the Mexican Tax System.

Table 2.1 Shows the structure of taxation from 1970 to 1985. The relative importance of different taxes can be seen. For example, income taxes account for about 40% of total taxes, with taxes on corporate incomes normally, but not always, above those on personal incomes.

The 1980 tax reform introduces the value-added tax in substitution of the purchase tax (ingresos mercantiles), a fact that can be seen in table 2.1. As a result of this, the share of these taxes increased from 11.9 % in 1970 to 30.7 % in 1984. Other points worth noting are import (tariffs) and export taxes. The latter represented in 1982, 29,8% of total taxes, due to oil exports. In 1983, this tax and a special tax on the production of oil were substituted by a duty on oil extraction, a fact that explains its drop to 7.3% in 1983 and then to 0.1% in 1984 and 1985.

The share of total tax revenue in gross domestic product shows a cyclical pattern that moves with the economic situation of the country. For example, in 1976, at the beginning of the oil boom, it was 11.3% (not shown). From then on, it increased steadily to 15.1% in 1982, when the last effects of the boom were still being felt. In 1983, due to the crisis started at the end of 1981, it fell sharply to 11.4% and then, in 1984, to 10.3%. Preliminary figures show a slight recovery in 1985 to 10.5%. In any case, this is a small figure when compared to other countries like the United Kingdom, with shares of 36% and 34% in 1970 and 1979, respectively.

2.2 Main Features of the Personal Income Tax Law

This work deals with taxes on personal incomes, which are classified, as shown in table 2.1, in taxes on wages and salaries, taxes on capital earnings, and in other, minor taxes. Parts of the ITL to be discussed below, are used as framework for the discussion on incidence and for the calculation of the data used. As we do not intent to give a detailed account of the contents of the law, but rather a brief summary showing its main characteristics and how they fit in this study, the interested reader is referred to S.H.C.P. (1977) or Dominguez and Calvo (1978).

TABLE 2.1

Sources of Tax Revenue, Mexico, 1970-1985

(Percentages and Millions of Current Pesos)

	1970	1977	1982	1983	1984	1985
TOTAL TAXES (Millions of Pesos)	36624	218654	1418847	1956242	2947747	4774826
Income Taxes	42.3	42.7	32.7	36.6	39.9	39.6
Taxes on Corporate Incomes	55.4	49.6	47.1	53.4	55.2	38.2
Taxes on Personal Incomes	40.7	49.4	52.4	46.2	44.3	47.8
Wages and Salaries	75.4	80.2	74.8	68.8	68.4	69.6
Capital Gains	19.7	14.1	22.3	26.0	26.9	24.2
Dividends, interest, trading income[d]	n.a	52.3	93.1	92.0	98.3	98.7
Other	4.9	12.2	2.9	5.2	4.8	6.2
Natural Resources[c]	2.6	1.8	2.3	-	-	-
Production and Trade[a]	18.6	22.0	12.4	22.2	22.7	21.4
Purchase Taxes[b]	11.9	18.5	-	-	-	-
Value-Added Tax	-	-	15.2	27.8	30.7	30.5
Import taxes	17.5	4.9	5.4	3.8	4.1	6.3
Export Taxes	2.7	7.1	29.8	7.3	0.1	0.1
Miscellaneous Taxes	4.5	2.9	2.1	2.2	2.5	2.2
GDP (Millions of Pesos)	444271	1849263	9417089	17141694	28748889	45588462
Share of Taxes in GDP (%)	8.24	11.82	15.07	11.41	10.25	10.47

Source: S.H.C.P., Indicadores Tributarios, various, years; SPP, INEGI, Estadísticas Históricas de México; B. de M., Informe Anual, 1985

a) From 1981, Production and services

b) From 1980 this tax was substituted by V.A.T.

c) During 1981 and 1982 production of oil tax. This tax along with oil exports' taxes were substituted in 1983 by a single duty on the extraction of oil. Duties (derechos) are considered as non-tax income and are, therefore, not shown on the table.

d) From 1981, The ITL reclassified the concepts so that comparison with previous years is only approximate.

One of the main features of the 1977 income tax law (and subsequent years), is the differentiation between cumulative and non-cumulative incomes. The idea behind this is that individuals with more than one income source, adds them together to determine only one taxable base, in order to increase progressivity.

The ITL discusses two situations that can occur, depending on the level and sources of income of the taxable unit, which in the Mexican case is the individual (the law does not contemplate households or couples as taxable units). In the first situation, taxable income is less than 100,000 pesos a year. This means that gross individual income can be as high as 125,000 pesos, since a deduction of 20% is allowed by the law. In this situation, the following cases can be found:

i) When taxable income arises from only one source, eg, work remunerations or professional services or capital income, only one taxable base is calculated.

ii) When taxable income comes from more than one source, eg, labour (work remunerations and/or profesional services) and capital. In this case, if individual income originates from work remunerations and profesional services, only one taxable base is calculated. If the earnings come from labour (any type) and capital (any type) then two taxable bases must be calculated, and the sum of both must be less than 100,000 pesos.

The second situation results when taxable income from one or various sources exceeds 100,000 pesos a year, in which case only one taxable base is calculated, and the individual is taxed according to its global income.

Depending on the situation the taxpayer is confronted with, which is in turn a function of the type and level of income, it will be taxed according to either of two schedules: the one in article 75 of the law, or the schedule in article 86. The latter is more progresive than the former, as it intends to tax the individual's global income and applies when the taxable base exceeds 100 000 pesos per year. Article 75 of the law is used for cases i) and ii) of the first situation mentioned.

An important aspect of the law, is the fact that the minimum legal wage, which is determined annually (and sometimes more often) by the government, is exempt from taxes and contributions. This means that people with incomes below the legal minimum are outside the ITL, and are therefore neutral for tax analysis.

An issue that has been the subject of debate in the last years, is the interaction between personal (taxable) income accruing to the individual directly and taxable income which he receives as owner of an enterprise. In other words, the problem is the composition of the taxable base for business owners, because its calculation implies not only legal elements from personal income taxation, but also from that part of the law dealing with taxation of corporate income.

Because of this, the distinction that the ITL makes between enterprises as major and minor taxpayers (causantes mayores y menores), according to their yearly gross income, is of particular importance. If it is less than or equal to 1,500,000 pesos, they are classified as minor taxpayers; enterprises whose income is more than 1,500,000 pesos a year are major taxpayers. In the first case, the ITL stipulates a flat rate of 5% on gross income. In the case of major taxpayers, the average corporation income tax rate in 1977 was 40%. These elements, as well as others on dividends, will be put together at the moment of calculating the data base and performing the simulations.

3. THE DATA BASE.

The simulations performed in this paper, used a tax data file generated from the 1977 Income and Expenditure Survey (ENIG77), carried out by the Secretaría de Programación y Presupuesto (SPP, 1977, 1977a). The data file was constructed by grossing up the income categories reported in the survey and calculating the base year tax variables. The reader is referred to appendix A for a detailed account of these calculations, as we present here only a brief summary.

3.1 Methodology for Grossing Up Income[3].

A serious problem when using the ENIG77 as data base for tax analysis, is the fact that income is reported net of taxes, of social security contributions and of other deductions, and that no tax payments and rates appear in the survey either. This means that gross income and all associated tax variables have to be found from net income using numerical techniques to obtain the final result, that is, a microdata set composed of the taxable units in the survey which fall within the Income Tax Law regime.

In order to gross up income, we have to proceed in two steps. The first one is to annualise the variables, since the ENIG77 is a six-monthly survey[4].

The second step is to use the annualised data to produce the file of gross individual income and tax variables in the base year. Although the idea is quite simple, ie, to find the amount of taxes paid by each individual starting from its net income, some items were particularly difficult to calculate. In order to do this, we used the 1977 Income

---

3. This section draws from previous work on tax incidence by Gil Díaz (1985).

4. Strictly speaking, the tapes used in this study reported income on a monthly basis. So, the figures were first multiplied by a factor of 6.

Tax Law and reversed numerically the mechanisms of tax determination that appear therein. The numerical techniques and the assumptions needed to annualise and to gross up income are discussed in appendix A, as well as the details of the calculations.

3.2 Calculation of Tax Payments and of Effective Tax Rates.

The final purpose of calculating the data, was the obtention of taxes paid by each taxable unit in the sample and of the effective tax rates associated (ERT's).

The effective rate of taxation is defined as the ratio of total tax payments to gross income ($\bar{GY}^h$), that is, income gross of all deductions[5].

$$ERT^h = T^h/\bar{GY}^h \qquad (3.1)$$

where

T^h = Total tax liabilities of individual h

$\bar{GY}^h$ = Total gross income of individual h

---

5. The definitions of effective and marginal rates of taxation follow Musgrave (1980), pp. 372-374. Note, however, that some authors, eg, King and Fullerton ( ), use a somewhat modified terminology, calling effective rate of taxation, what we call here, marginal rate of taxation , that is, the derivative of taxes with respect to income.

Total gross income is just the sum of the (gross) income categories for each individual found when calculating the tax data base, referred to as MASTERF from now on. Note that the i subscript indicates income categories in table A.1.[6].

$$GY^h = \sum_{i=1}^{n} Y_i^h \qquad (3.2)$$

The calculations of total tax payments, T^h, were made in two steps, once again following the mechanisms of the law. In the first one, we accumulated the income categories which, according to the law, must be declared jointly, and determined a unique taxable base, a "cumulative taxable base" (ATB^h), with which we obtained the corresponding tax payments, TAC^h, that is:

$$ATB^h = BG_{11}^h + BG_{152}^h + BG_{21}^h + BG_{22}^h + BG_{24}^h + BG_{31}^h \qquad (3.3)$$

$$TAC^h = f_t + [m_t \ (ATB^h - \bar{Y}_t)] \qquad (3.4)$$

---

6. The income categories in question are: 11, 152, 121, 122, 123, 124, 131, 132 and 133. In the following equations only the last two digits are used.

where the numbered subscripts indicate the types of income to be globalised (accumulated), and,

BG_i^h = Taxable income of type i, individual h

f_t = Tax on lower limit faced by all individuals in tax bracket t

m_t = Marginal tax rate for all individuals in tax bracket t

$\bar{Y}_t$ = Lower taxable income limit faced by all individuals in tax bracket t

In the second step, we calculated tax payments from income categories which are not cumulative in the following way:[7]

$$
\begin{aligned}
T_{22}^h &= \bar{Y}_{22}^h - N\bar{Y}_{22}^h \\
T_{23}^h &= \bar{Y}_{23}^h - N\bar{Y}_{23}^h \\
T_{32}^h &= \bar{Y}_{32}^h - N\bar{Y}_{32}^h \\
T_{33}^h &= (0.4)\ \bar{Y}_{33}^h + (.21)\ (N\bar{Y}_{33}^h \times 1.27)
\end{aligned}
\qquad (3.5)
$$

7. The variable BG22, business income, appears in equation (3.3) when it is defined for a major taxpayer, in which case it is globalized. When it appears in equation (3.5), it belongs to a minor taxpayer and is taxed at a flat rate of 5%, and not accumulated.

The first three equations define tax payments as the difference between gross and net (NY_i^h) income. The fourth equation deals with tax payments from dividends and the details are given in appendix A.

Total tax payments are:

$$T^h = TAC^h + T_{22}^h + T_{23}^h + T_{32}^h + T_{33}^h \qquad (3.6)$$

where the subscripts refer to the last two digits of the income categories in table A.1, and TAC^h is the level of cumulative tax payments.

3.3 MASTERF: A Data File for Tax Microsimulations

The completed data base contains a total of 92 variables per taxable unit, and there are 10747 cases in the sample which were defined as taxpayers[8]. The variables are grouped into i) economic and socio-demographic characteristics of the household to which the taxable unit belongs ii) same as before, for the individual; iii) gross and net income by types and, iv) tax variables, ie, tax liabilities and tax rates. When the sample is expanded, the number of taxable units represented is 10 005 216, out ot a total of 11 115 142 households. This gives an average of 0.9 taxpayers per household. Full documentation and description of MASTERF can be found in Baillet (1986).

---

8. Originally, the sample of income earners consisted of 18044 cases. However, we left out of MASTERF, by assumption, those cases with a gross income under 4800 pesos, ie, the lowest limit in the taxable income schedule. Below this limit, individuals are assumed to pay no taxes.

4. Results in the Year of Reference and Simulations Performed.

This section discusses the results of the simulations; they aim at showing how tax changes affect the taxable units. Such tax changes correspond to actual policies implemented by the Mexican government in some cases, while they are of a more exploratory type in others. First, we describe the results in the year of study.

4.1 The Tax System in 1977: Some Analysis.

Table 4.1 shows the results grouped by taxable income brackets, those in article 75 of the law, expanding the sample to the population. The overall effective tax rate is 16.7%. The effective rates of taxation which apply to each income bracket show the degree of progressivity of the tax system, as they are calculated with respect to income gross of personal exemptions and deductions.

Figure 4.1 shows this clearly, where an overall smooth pattern of progressivity emerges. This pattern can however be divided in three segments. The first one includes income brackets 2 to 11 and is almost flat. The second one stretches from bracket 12 to 22 with gradual increases and the last one, including the top income brackets shows a much higher degree of progressivity. In particular, the sudden increase found between groups 25 and 27 is due to its income composition and statistical representativity in the sample, as will be seen below.

The weighted marginal tax rates appearing in column (5) of table 4.1, were calculated for each group as follows:

TABLE 4.1

TAX RATES AND REVENUE SHARES BY TAXABLE INCOME GROUPS, 1977[a]

(Taxpayers and Percentages)

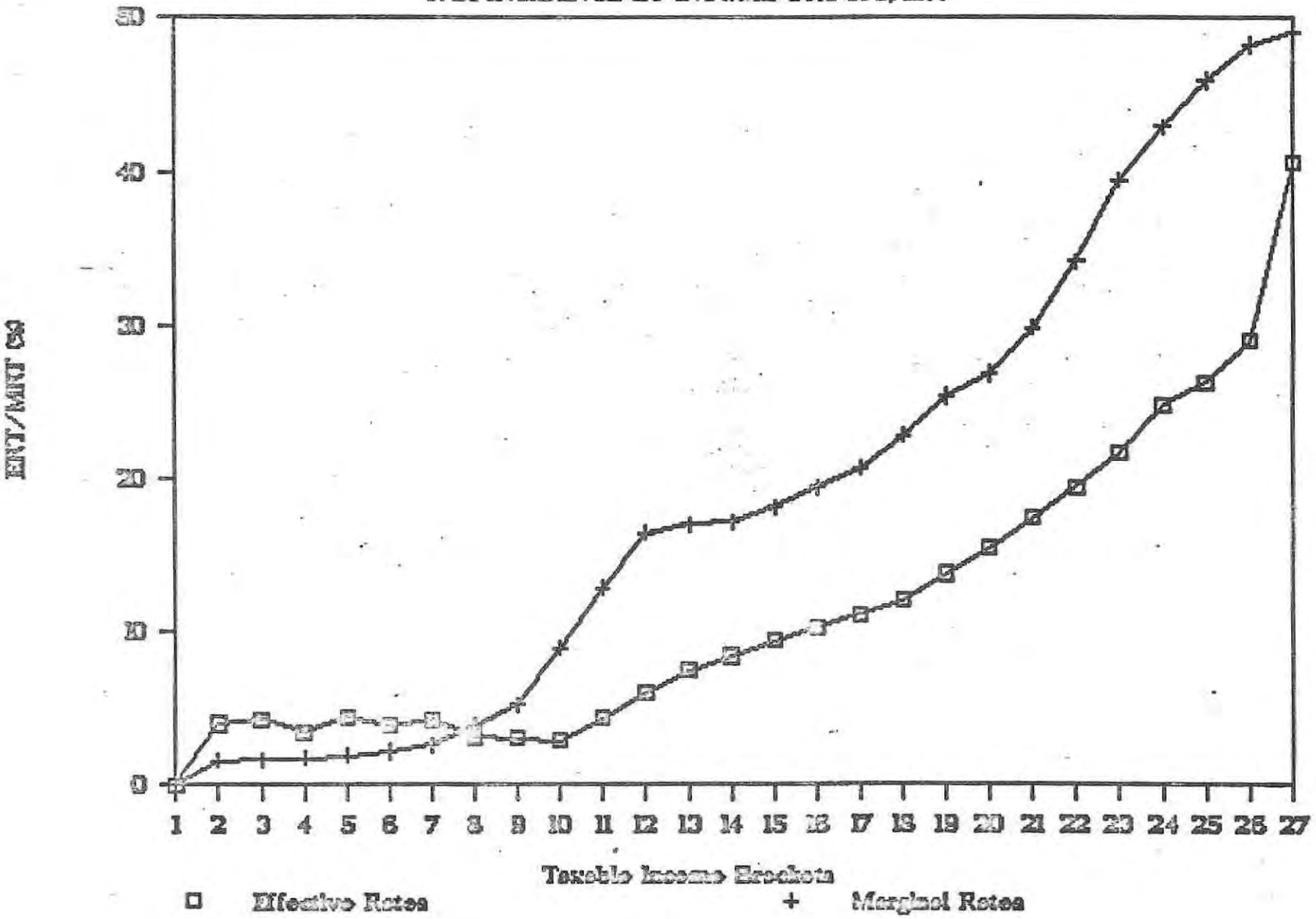
Taxable Income Bracket (1)	Number of Taxable Units[c] (2)	Number of Taxable Units[d] (3)	Effective Rates of Taxation (4)	Weighted Marginal Tax Rates (5)	Tax Reven Share (6)
1	0	0	0.0	0.0	0.0
2	222	247540	3.977	1.580	0.038
3	215	244456	4.311	1.690	0.049
4	95	97441	3.447	1.780	0.017
5	160	173134	4.480	1.910	0.045
6	120	133451	3.857	2.190	0.034
7	564	596600	4.309	2.608	0.221
8	197	194498	3.173	3.865	0.073
9	96	77866	3.083	5.250	0.037
10	843	718761	2.899	8.928	0.490
11	2293	2054744	4.365	12.891	2.637
12	1507	1387485	6.010	16.482	3.119
13	927	825364	7.480	17.011	2.756
14	683	651507	8.408	17.187	2.884
15	613	592340	9.469	18.135	3.434
16	378	327488	10.306	19.466	2.340
17	198	180874	11.160	20.698	1.522
18	544	496501	12.064	22.814	5.251
19	312	279547	13.788	25.382	4.096
20	236	228896	15.482	26.871	4.560
21	153	131590	17.410	29.836	3.520
22	164	143231	19.492	34.204	5.169
23	95	86912	21.653	39.508	4.403
24	50	51842	24.878	43.005	3.651
25	24	23687	26.323	45.980	2.038
26	18	16634	29.004	48.300	1.745
27	40	42829	40.671	49.088	45.874
TOTAL	10747	10005216	16.750	-	138111.7[b]

Source: Own calculations

a) All results are calculated for the expanded sample
b) Millions of 1977 pesos
c) In the sample, ie, MASTERF
d) Expanded sample

Figure 4.1

TAX INCIDENCE BY INCOME GROUPS, 1977



$$WMR_t = \left[\frac{m_t \sum_{\substack{h=1 \\ h \epsilon t}}^{H_t} (ATB^h \cdot e^h)}{\sum_{\substack{h=1 \\ h \epsilon t}}^{H_t} (ATB^h \cdot e^h)} \right] .100 \qquad , \forall t \qquad (4.1)$$

$$t = 1,2,\ldots,27$$

where e^h is the expansion factor of individual h and H_t the number of taxpayers in group t.

Note that the marginal rate for the group is the same as the individual rate, whenever we are dealing with taxable income which is not the result of adding up incomes of the cumulative and non-cumulative types. When this happens, the value of the marginal rate for the group is no longer the same as for the individual. The progressivity of the marginal rate schedule is very pronounced all along the income scale, apart from groups 12 to 15, where it tends to be flatter.

In terms of revenue shares, the first 10 groups, accounting for 25% of the population, contribute with only 0.7% of total revenue. The last 3.6% of the population, groups 22 to 27, contribute with almost 63% of the revenue, and, what could be called the "middle classes", 71.4% of the population, add the remaining 36.3% to revenue. It would seem that the tax schedule is imposing a rather heavy burden on the lower and upper classes when compared to the "middle classes", which are relatively better off. From the point of view of revenue, the contribution of the lower classes is negligible and that of the middle classes quite low. This indicates the need for -

introducing tax policies in order to make the middle part of the tax schedule more progressive, so as to increase the revenue share of the "middle classes", and the lower part less progressive, without any noticeable loss of revenue. This conclusion is supported by the fact that for groups 2 to 7, the effective rate of taxation is higher than the marginal rate, indicating that due to the income composition of such groups, they are, as a matter of fact, bearing a heavy burden.

However, the average figure reported cover individual situations within each group. For example, looking at table 4.2, in group 2 the range of effective rates found is from 0.7% to 17.4%, ie, 16.7%, while the average is 3.8%. Similarly, the range in group 16 is 7.6% from 5% to 12.6%, and an average of 10.3%. For the top group, the corresponding values are 32.3%, 17.7% and 50%.

The coefficient of variation shown in columm (6), indicates the percentage that represents the standard deviation in the mean, and, as such, is a measure of the dispersion of the ERT in each group. Thus, the tax groups with the lowest coefficients of variation, such as 16 and 19 are those with the more symmetrical and less spread distributions. In these groups, the effective rates of taxation faced by the taxpayers are fairly similar.

The classification by taxable income groups allows us to compare them in term of horizontal equity, defined as equal (tax) tratment to (income) equals[9]. If any group shows total equity, its dispersion should be zero, and the mean, median and mode should be equal. As the within-group inequity grows,

---

9. This definition follows again Musgrave (1980), pp. 242-243. Some authors define equity in terms of utility and consider issues such as work and leisure, its relationship to utility and therefore its effects on equity. Given the scope of this work, we have not considered this view.

T A B L E 4.2

INTRAGROUP COMPARISON OF ERT's BY TAXABLE INCOME GROUP

(Percentages)

Taxable Income Group (1)	Average ERT (2)	Lowest ERT (3)	Highest ERT (4)	Range (5)	C.V.[a] (6)	Mode (7)
1	0	0	0	-	-	-
2	3.8	0.7	17.4	16.7	63.15	5.0
3	4.1	0.9	17.4	16.5	53.65	5.0
4	3.1	1.0	5.0	4.0	64.51	5.0
5	4.2	1.1	5.0	3.9	35.71	5.0
6	3.8	1.2	5.0	3.8	47.37	5.0
7	4.1	1.3	17.4	16.1	51.22	5.0
8	3.1	1.7	5.0	3.3	45.16	5.0
9	3.1	2.3	17.4	15.1	70.97	2.4
10	2.9	2.4	10.7	8.3	17.24	2.8
11	4.3	2.9	17.4	14.5	16.28	4.2
12	6.0	3.0	17.4	14.4	13.33	6.3
13	7.5	3.8	17.4	13.6	13.33	7.2
14	8.5	4.2	17.4	13.2	12.94	7.9
15	9.5	5.0	17.4	12.4	12.63	9.0
16	10.3	5.0	12.6	7.6	10.68	9.9
17	11.2	7.4	24.2	16.8	14.285	10.4
18	12.1	5.0	15.3	10.3	12.396	10.8
19	13.9	10.0	16.9	7.0	10.79	12.5
20	15.8	5.0	18.7	13.7	12.025	14.0
21	17.4	15.0	20.3	5.4	10.92	15.9
22	19.6	13.7	23.5	9.8	12.76	22.5
23	22.0	15.8	26.3	10.6	12.73	19.1
24	25.5	17.4	28.4	11.0	10.98	28.3
25	26.0	16.1	31.4	15.3	16.92	25.1
26	29.2	5.0	32.8	27.8	23.28	32.8
27	43.4	17.7	50.0	32.3	20.97	50.0

Source: Own calculations

Notes: a) The coefficient of variation is defined as the standard deviation divided by the arithmetic mean and multiplied by 100.

its dispersion should grow as well and, most certainly, the three measures mentioned would not be equal. We have thus, in the range and in the coefficient of variation, rough indicators of inequity. According to this, groups 2, 17, 26 and 27 show the highest degree of inequity, and group 8 the lowest.

In order to explain the dispersion found, we have taken a closer look at the individual cases, isolating six of them, three in low income brackets (group 2) and three in high income brackets (group 27), with similar levels of taxable income but different effective rates (table 4.3).

The observed differences in rates, despite the similar levels of taxable income, are explained by the composition of income and by the Income Tax Law regulations. The figures in table 4.3 illustrate the fact that horizontal equity is not maintained for certain types of income, mainly capital income, as well as the importance of the income source, and the fact that there are some cases in which the structure of income means lower effective rates of taxation at higher levels of taxable income (case 3, high income), accentuating in this manner horizontal inequity.

It can be concluded from these examples that the Income Tax Law is designed to tax more heavily capital income than work remunerations, and that horizontal equity is lost when similar levels of taxable income arise from different sources. Besides, the more diversified is the composition of income of an individual and the more this income is of the cumulative type, the higher the effective rate that he has to confront. This is the main reason explaining the results of simulation 1, below.

TABLE 4.3

HORIZONTAL INEQUITY: SELECTED CASES

(1977 pesos)

A) Low Levels of income

Concept	Case 1	Case 2	Case 3
Taxable income	5607.9	5494.5	5579.2
Tax payments	46.5	274.6	970.6
Marginal rate	1.58%	0.0	0.0
Effective rate	0.83%	5%	17.4%
Types of income			
Other cumulative income[c]	5607.9	0	0
Business income[d]	0	5494.5	0
Non-cumulative income[e]	0	0	5579.2

B) High levels of income

Concept	Case 1	Case 2	Case 3
Taxable income	555478.1	530085.7	1711892.7
Tax payments	98443.7	265042.8	679212.6
Marginal rate	34.5%	50%	8.9%
Effective rate	17.7%	50%	39.7%
Types of Income			
Wages and salaries	240857.2	0	0
Other cumulative income	0	530085.7[a]	26170.2[b]
Dividends	0	0	1685722.5
Interests	254406.6	0	0

Source: Own calculations

a) Business income: major taxpayer
b) Rents of Cand
c) Rents of houses
d) Minor taxpayer: Non-cumulative income.
e) Interest income

4.1.1 The Tax System in 1977: Classification by half-deciles

Several works on tax incidence present the results ranking taxable income of the groups studied by deciles or half-deciles[10]. This method, which ranks raxable units from the lowest to the highest level of income, has some limitations to show the degree of progressivity of a taxable system, because it depends critically on the current distribution of income as opposed to the tax system itself.

However, for purposes of comparison with previous studies and in order to obtain a different picture of the tax system, we have done the calculation ranking the agents by half-deciles. The results are shown in table 4.4 and figures 4.2 and 4.3. The general effective tax rate is 17.5. Column (5) shows the income-weighted marginal tax rate and columns (6) and (7) the revenue shares for each group, for the sample and for the country.

The structure of the shares is quite interesting . First, we note that the revenue shares are almost identical before and after the expansion of the sample. Second, the contribution to tax revenue is heavily concentrated in the last 5 half-deciles, with 87% of the total. This result shows the high concentration of income in the upper tail of the distribution, and the fact that the personal income tax structure becomes highly progressive for the highest income groups. This can be observed in column (3) of table 4.4 and on figure 4.2.

---

10. See, for example, Musgrave et al., (1974), Pechman and Okner, (1974) and Gil Diaz, (1985).

TABLE 4.4

TAX RATES AND REVENUES BY HALF-DECILES IN 1977

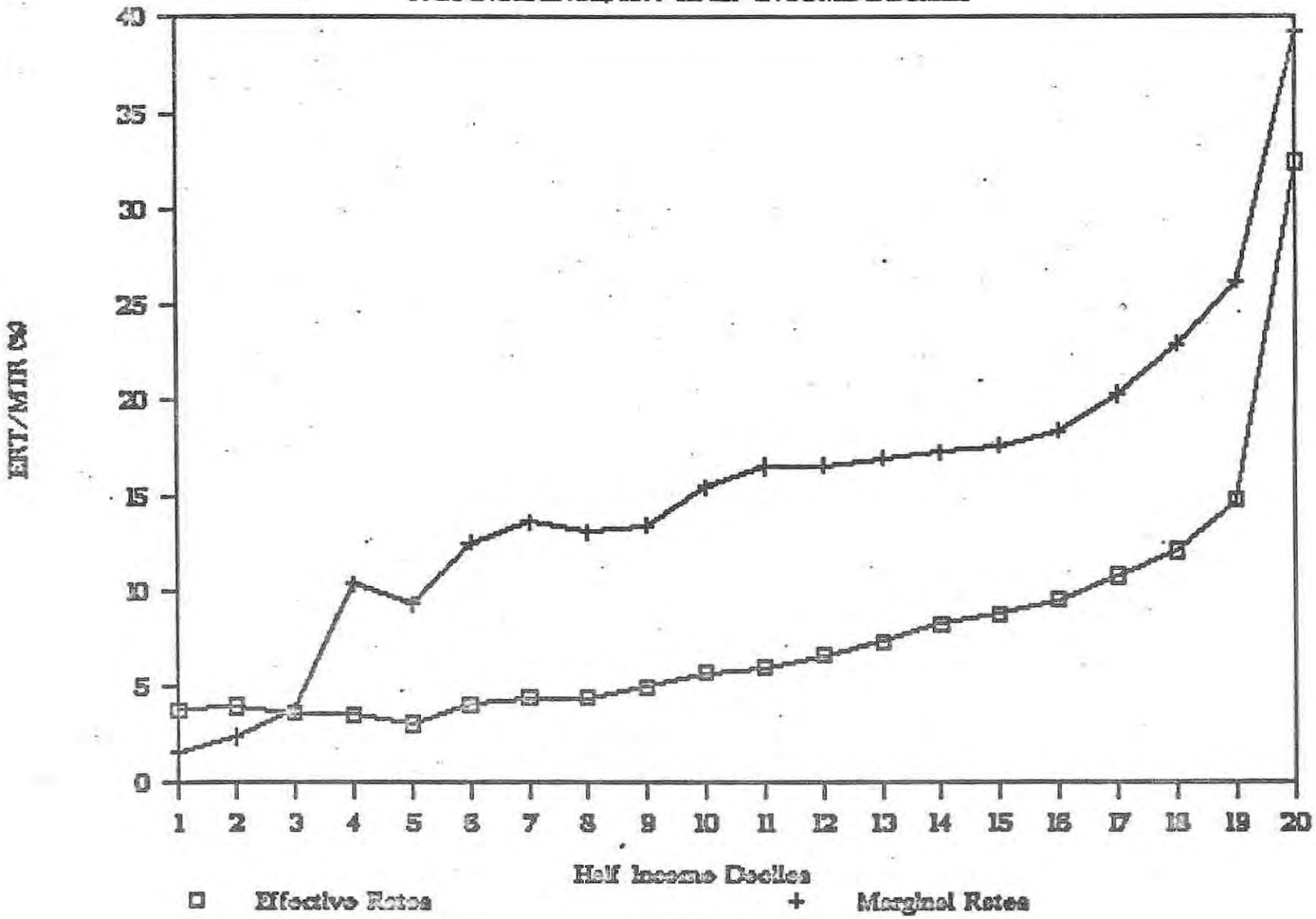
(Percentages)

Half Deciles[a] (1)	Nr. of Taxable Units[c] (2)	Efective Rate of Taxation (3)	Mean Marginal Tax Rate (4)	Weighted Marginal Tax Rate (5)	Tax Revenue Share Sample (6)	Tax Revenue Share Expanded (7)
1	538	3.803	0.523	1.683	0.076	0.105
2	538	3.967	0.668	2.408	0.124	0.164
3	538	3.633	1.662	3.789	0.176	0.222
4	538	3.528	9.585	10.364	0.340	0.393
5	538	3.055	9.172	9.290	0.341	0.340
6	538	4.096	12.359	12.522	0.495	0.511
7	538	4.377	13.336	13.639	0.580	0.624
8	537	4.373	13.004	13.088	0.612	0.621
9	537	4.963	13.329	13.432	0.734	0.876
10	537	5.725	15.294	15.434	0.911	1.076
11	537	5.997	16.365	16.547	1.027	0.999
12	537	6.606	16.732	16.595	1.240	1.341
13	537	7.319	17.001	16.944	1.474	1.565
14	537	8.248	17.420	17.304	1.863	2.001
15	537	8.789	17.719	17.586	2.191	2.505
16	537	9.475	18.577	18.382	2.711	3.035
17	537	10.797	20.433	20.322	3.544	3.713
18	537	12.083	23.228	22.984	4.856	5.207
19	537	14.715	26.525	26.246	7.896	8.665
20	537	32.475	36.757	39.243	68.809	66.036
TOTAL	10747.0	17.500[a]	-	-	92.5[b]	87724.1[b]

Source: Own calculations

Notes:
a) The overal effective rate of taxation is calculated on the sample and differs slightly from that obtained for the whole population.
b) Millions of pesos.
c) In order to homogenize the groups, an extra taxpayer has been included in half-deciles 1 to 7.

Figure 4.2


TAX INCIDENCE, 1977 HALF INCOME DECILES
EFT/MTR (%)
40
35
30
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Half Income Deciles
Effective Rates
Marginal Rates

The graph shows that the tax system is slightly progressive, almost proportional, for the first 8 half-income deciles, becoming more and more progressive after that, and ending up with a sudden increase between half-deciles 18 and 20. The reasons of this behaviour can be found mainly in the composition of taxable income. This income is basically wages and salaries at low and middle levels of earnings, with a small dispersion and fairly similar effective rates of taxation. As individuals become richer, their sources of income tend to diversify, with capital income playing a more important role in its composition. Thus, the proportion of taxes paid with respect to income grows rapidly.

With respect to the pattern of progressivity in figure 4.2, it is interesting to compare Gil Díaz's (1985) findings and ours, displayed in figure 4.3. Although the concepts of effective rate of taxation are not strictly equivalent in both studies due to the income concept used, they are similar enough so as to allow for a good comparison. Note also that despite the similarities of the results, both studies proceeded in a fairly different way to obtain them, and that in our case we worked with a highly disaggregated file of taxable units.

First, observe that our rates are, on average, lower than his. Second, the similarity of the rates between half-deciles 2 and 10 an 18-20 is quite high; third, the behaviour of the effective rates between groups 11 and 17 is markedly different. While we obtain a rather smooth, progressive pattern, Gil Diaz obtains a highly uneven pattern, that he attributes to the individual income tax and in particular to differences in the composition of income of such groups[11].

Without trying to elucidate the numerous methodological and statistical aspects which explain the differences found,

---

11. The rates of taxation used for figure 5.2 can be found in Gil Díaz (1985), p. 69, table 4.6 column 4.

both studies point towards a fiscal system moderately progressive, near proportional, at low levels of income, becoming steadily progressive after the 10th half-decile, and ending up with a brusque increase in the rate of progressivity at high levels of income.

4.1.2. A decomposition of the 1977 Tax Schedule[12].

We showed in previous sections the way in which the tax schedule is organized, that is, in taxable income brackets with a corresponding fixed amount, or quota, and a marginal tax rate which applies to the income resulting from the difference between the taxable base and the lower limit of the relevant bracket. In this way, the tax schedule can be seen as a "table" which is confronted by the taxpayer , once he has calculated his taxable base, and that indicates him, how much taxes to pay as a function of the fixed quota and the marginal tax rate.

Another way of analysing and describing the tax system in 1977 is by reinterpreting the schedule in terms of marginal tax rates, eliminating the fixed quotas and showing individual tax payments as a function only of marginal tax rates, ie, the tax rate of the bracket relevant to that person, and a fraction of the tax liabilities paid according to the marginal rates of each of the previous income brackets. If we let T be total tax payments in the economy, we can express the decomposition of the tax schedule in its most general form as follows[13]:

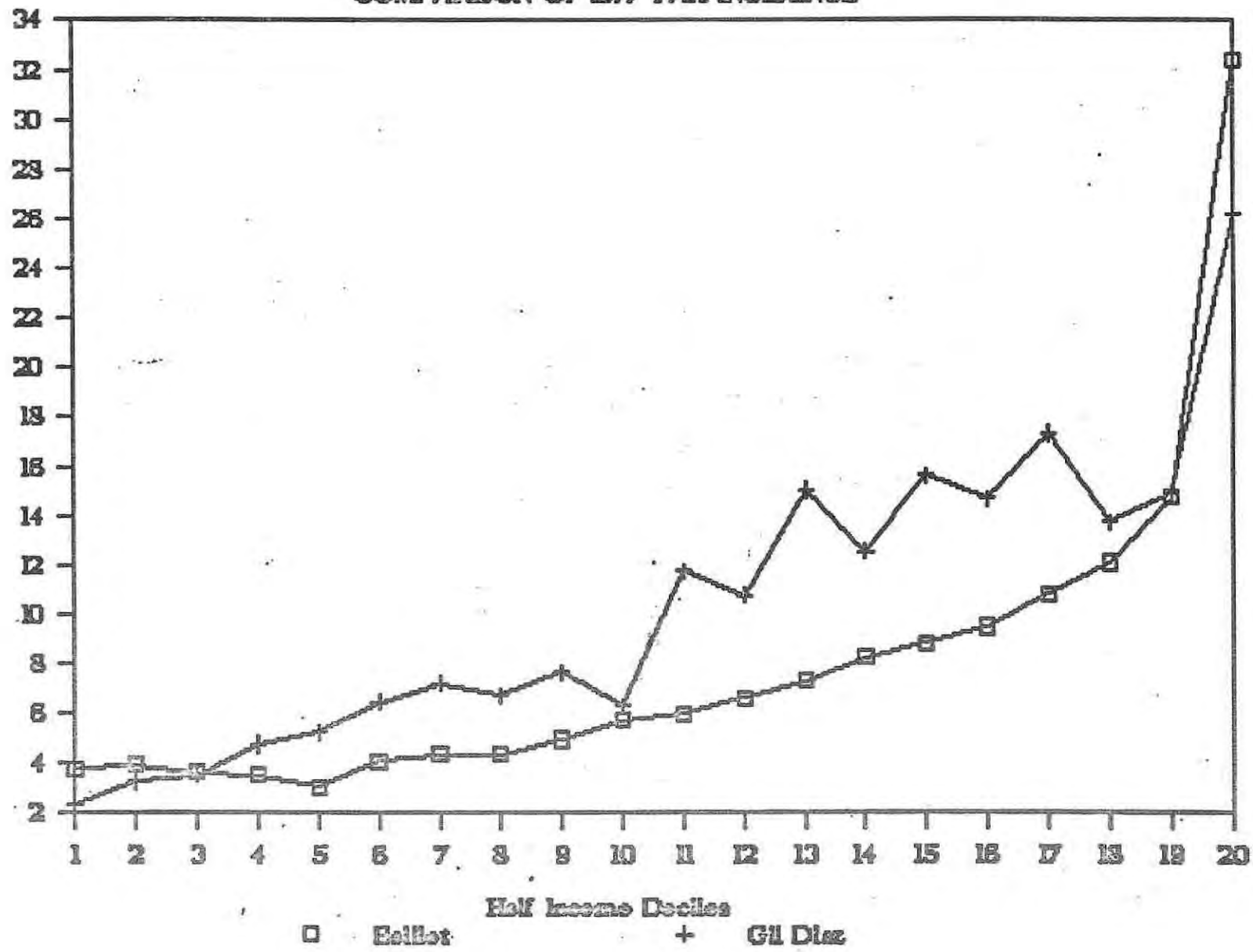
---

12. Thanks to J. Seade for the initial idea of this decomposition.

13. Note that there are no taxpayers in bracket 1 since they are tax-exempt, and that the marginal rate is zero.

Figure 4.3

COMPARISON OF 1977 TAX INCIDENCE



$$T = f^1 + m_2 \left[\sum_{h=1}^{H_2} (Y_2^h - \bar{Y}_1) + (\bar{Y}_2 - \bar{Y}_1)\ (H - H_2) \right]$$

$$+ m_3 \left[\sum_{h=1}^{H_3} (Y_3^h - \bar{Y}_2) + (\bar{Y}_3 - \bar{Y}_2)\ (H - \sum_{t=2}^{3} H_t) \right]$$

$$+ m_4 \left[\sum_{h=1}^{H_4} (Y_4^h - \bar{Y}_3) + (\bar{Y}_4 - \bar{Y}_3)\ (H - \sum_{t=2}^{4} H_t) \right]$$

$$+ m_5 \left[\sum_{h=1}^{H_5} (Y_5^h - \bar{Y}_4) + (\bar{Y}_5 - \bar{Y}_4)\ (H - \sum_{t=2}^{5} H_t) \right]$$

$$\vdots \qquad \vdots$$

$$+ m_{27} \left[\sum_{h=1}^{H_{27}} (Y_{27} - \bar{Y}_{26}) \right] + f^u\ (H_{27})$$

(4.2)

$$T = \sum_{h=1}^{H} T^h$$

$H = \sum_t H_t$ = Total number of taxpayers in the population

$H_1, \ldots, H_{27}$ = Number of taxpayers in each income bracket ($H_{1=0}$)

$m_1, \ldots, m_{27}$ = Marginal tax rates ($m_{1=0}$)

$Y_1^h, \ldots, Y_{27}^h$ = Levels of individual taxable income by bracket ($Y_{1=0}^h$)

$\bar{Y}_1, \ldots, \bar{Y}_{26}$ = Upper and lower limits of the taxable income brackets

f^1, f^u = Lowest and highest fixed quotas.

Each term in the equation is formed by two parts. The first one represents the taxpayers falling in that bracket; the second one is the rest of taxpayers whose payments contribute somewhat to that particular bracket, when such payments are expressed as a succession of amounts determined by the marginal rates.

In fact, equation (4.2) is an alternative way of calculating total tax liabilities which were previously found by means of equations (A5) in appendix A. At the individual level, the previous expression reduces to:

$$T_t^h = f^l + m_2 (\bar{Y}_2 - \bar{Y}_1) + m_3 (\bar{Y}_3 - \bar{Y}_2) + \ldots + m_t (Y_t^h - \bar{Y}_t) + f^u \qquad (4.3)$$

where the subscript t, denotes the bracket in which taxable income of individual h, Y_t^h, falls. Y_t^h can in fact be seen as a parameter which limits the extension of the equation. Thus, if Y_t^h for a given individual falls in the highest bracket, the equation giving its tax liability will contain 26 terms as well as the fixed upper quota, f^u; if it falls in bracket 10, it will contain 9 term and no f^u, and so on. Combining expressions (4.2) and (4.3) we can obtain total tax payments per group.

To make the idea more precise, suppose that the economy is formed by only three taxpayers, with different taxable incomes, one in bracket 3, one in bracket 4, and one in bracket 5. According to expression (4.3), the taxpayer's liabilities would be:

$$T_3^1 = f^1 + m_2(\bar{Y}_2 - \bar{Y}_1) + m_3 (Y_3^1 - \bar{Y}_2)$$

$$T_4^2 = f^1 + m_2(\bar{Y}_2 - \bar{Y}_1) + m_3 (\bar{Y}_3 - \bar{Y}_2) + m_4 (Y_4^2 - \bar{Y}_3)$$

$$T_5^3 = f^1 + m_2(\bar{Y}_2 - \bar{Y}_1) + m_3 (\bar{Y}_3 - \bar{Y}_2) + m_4 (\bar{Y}_4^2 - \bar{Y}_3) + m_5 (\bar{Y}_5^3 - \bar{Y}_4)$$

(4.4)

The amount of taxes paid by the three taxable units up to bracket number 2 is exactly the same, because only constants enter the calculation. However, from bracket 3 onwards, the amount of taxes paid by each individual will be different according to whether their taxable income falls in that bracket or not. If we add vertically the f^1 terms and the terms in parenthesis on the right hand side of expression (4.4) we find, firstly, total fixed minimum payments, and, secondly, total taxable income in each bracket of the law to which the same marginal rate applies. For example, the vertical addition of the 3th. terms, gives us total taxable income in the economy in bracket 3, which is taxed according to m_3. We call this sum, total incomes in each bracket.

The advantages of calculating individual fiscal payments in this way are that, if we know the total amount of taxable income which is taxed according to each of the marginal rates in the law, we can inmediately know the effects on tax revenue of: i) changes in those rates; ii) changes in the width of the brackets, and iii) changes in taxable income itself. This information can be used to answer a great variety of questions, in which any of the variables intervening in the decomposition formula appear, as discussed below.

We performed the calculations just illustrated to the expanded sample in MASTERF, and the results were aggregated according to the brackets in the law. Table 4.5 shows the final outcome. Note that the results obtained with table 4.5 apply only to individuals whose income is of the cumulative type.

In column (5), we have the results of the vertical sum of the marginal terms in each group, ie, the marginal incomes in each bracket, and in column (6) the vertical sum of total differences in the extended formula for tax payments, ie, the vertical sum of the differences between the highest and lowest entries in each bracket, and of the differences between the taxable income level for each individual and the lower limit in the bracket, what we called above, total incomes in each bracket. In this way column (5) is contained in column (6). Column (7) is the product of columns (4) and (6) plus the fixed lower quotas in column (3). Adding the total results in column (7) and the fixed upper quotas, we obtain total tax payments in 1977 due to income of cumulative type (see notes i) and ii) in table 4.5).

Section 4.2.2 shows one of the applications of the decomposition of the tax schedule.

TABLE 4.5

DECOMPOSITION OF THE INCOME TAX SCHEDULE

(Thousands of Pesos)

Taxable Income Bracket (1)	Nr of Taxpayers (2)	Fixed Lower Quotas (3)	Marginal Tax Rate (4)	Marginal Incomes in each Brackets (5)	Total Incomes in Each Bracket (6)	Total Tax Payments (3)+[(4)x(6)] (7)
1	0	0.0	0.0	0.0	0.0	0.0
2	69603	2349.1	0.0158	25596.4	8324244.0	133872.2
3	50528	1705.3	0.0169	23534.9	8273675.0	141530.4
4	44266	1494.0	0.0178	20931.4	8228579.0	147962.7
5	25086	846.7	0.0191	12396.6	8195964.5	157389.6
6	41486	1400.1	0.0219	18554.4	8162296.0	180154.4
7	133700	4512.4	0.0264	272563.9	40349724.0	1069745.1
8	114181	3853.6	0.0393	260636.0	39789728.0	1567589.8
9	67442	2276.2	0.0536	140801.8	39346228.0	2111234.0
10	713765	24089.6	0.0894	1891960.5	37671420.0	3391914.5
11	2056754	69415.4	0.1291	10363831.0	62177880.0	8096579.0
12	1375826	46434.1	0.1653	6361733.0	44967848.0	7479619.5
13	816265	27549.0	0.1705	3346831.3	34116796.0	5844462.5
14	644836	21763.2	0.1722	2277950.3	26857534.0	4646630.5
15	588857	19873.9	0.1815	2681470.0	21608086.0	3941741.5
16	321867	10863.0	0.1950	1579159.0	17415822.0	3406948.0
17	177545	5992.2	0.2081	687865.6	14820086.0	3090052.0
18	482728	16292.1	0.2290	4091527.0	27836752.0	6390908.0
19	275236	9289.2	0.2546	2219043.0	19358612.0	4937991.5
20	231160	7801.6	0.2690	2696501.0	17186156.0	4630877.5
21	137185	4630.0	0.2987	2069953.8	12444089.0	3721679.5
22	140857	4753.9	0.3445	3699592.0	15996406.0	5515516.0
23	85810	2896.1	0.3990	2054505.9	9202703.0	3674774.8
24	49033	1654.9	0.4310	1567090.4	5773318.0	2489954.8
25	22819	770.1	0.4650	585991.3	3423080.0	1592502.4
26	15547	524.7	0.4830	436253.4	2975294.5	1437591.9
27	31738	1071.2	0.5000	10547424.0	10547424.0	5274783.0
TOTAL	8714121	294101.6	-	59933696.0	545049792.0	85073992.0

Source: Own calculations and article 75 of the 1977 Income Tax Law.

Notes: i) Total tax payments due to income of cumulative type in the population, are arrived at as follows:

$T = 85073992.0 + 2650155.0 = 87724147.0$ thousands of pesos.

ii) Fixed upper quota of 83501 pesos/taxpayer, not shown in the table, is an adjustment needed in the upper end of the tax schedule (bracket 27 only), in order to take into account the increase in progressivity at that end. The total, 31738 x 83.501 = 2650155 thousands of pesos, becomes part of global tax payments. See equation 4.1.

4.2 The Simulations

Most incidence studies establish translation hypotheses about who, in the end, is to bear the tax burden. Pechman and Okner (1977) and Musgrave et al. (1975), eg, simulated changes in the translation hypothesis concerning the distribution of the tax burden, and analyzed the effects of this on the progressivity of the system. However, the main hypothesis in this work is that such translation of the burden does not exist in this context and that the incidence of taxation falls completely on the taxpayer. Although it could be argued that, for example, taxes on entrepreneurial income and on dividends are shifted forward to consumers, we keep the assumption that they are not, and that these taxes are borne by the owner of the enterprise, or the recipient of the dividend.

It is important to bear in mind that this is a study on direct taxation of individual income, and that the central idea is to analyze how changes in tax policy affect the welfare of the taxable units. Because of this, and because shifting forward taxes on personal income is less likely to happen than shifting forward indirect taxes, we assume that the tax burden is totally absorbed by the taxpayer.

In this paper we provide a set of simulations which aims at answering questions of two basic types. The first one could be called "policy-oriented" questions, such as the effects of past (and prospective) changes in the Income Tax Lax on the incidence of taxation; the second type of questions has a more methodological purpose in the sense that it ilustrates how the reinterpretation of the tax schedule in the ITL developed in section 4.1.2, can be used to greatly simplify the application of this framework to other questions or problems.

4.2.1. Simulation 1. Accumulating Taxable Income.

The first simulation performed deals with the fiscal treatment of the two basic types of income accruing to a taxable unit: income which has to be accumulated in order to determine the taxable base, and income which is taxed according to a regime of flat rates and need not be accumulated. The four types of non cumulative income are i) income from "house industries", ii) interest income, iii) income from the ownerships of small business (minor taxpayers), and iv) dividends.

Even before 1977, the tendency of the Mexican government has been to increase the degree of accumulation of income forming part of the taxable base, thus expanding the size of the latter, reducing tax avoidance and therefore increasing revenue.

In this simulation we assumed that all types of income are to be accumulated in only one taxable base per individual, and recalculated the tax liabilities and associated rates. Of course, only those taxable units with at least one type of non-cumulative income in the base year were affected by the simulation. Individuals whose only source of taxable income in the reference year was of the cumulative type, remained without change. As in the previous exercise, gross income and the tax rate schedule are kept at their original levels; the only parameter changing is the taxable base.

There are some points concernning the simulation that should be noted now. First, the effect of this simulation on taxpayers is to homogenize them into a single group which is taxed according to a taxable base resulting from the sum of all types of income that the individual receives. This means that the income bracket classification criteria used before, is not strictly comparable to the one used now. Because of this,

the results obtained in this simulation were compared to the effective rates of taxation in the year of reference, obtained from taxpayers with at least one type of cumulative income, leaving aside all categories of non-cumulative income. The comparison is then made between the progressivity of the tax system in the year of reference for incomes of the cumulative type only, and the simulated progressivity which assumes that all income is cumulative. This eliminates the distorsions in the comparison of the rates that would be included, had we taken all types of income in the base year.

Second, the revenue shares and overall effective rates in the simulation are compared to the general results in table 4.1, and not to the particular results in the subset fo taxpayers with at least one type of cumulative income.

Table 4.6 shows the results. Column (3) is the reference value of ERT's for the subset of taxpayers with cumulative incomes, while the rest of the table deals with the simulation's results. The total increase in the overall effective rate of taxation and in revenue is 9.7%.

The effects on the progressivity of the tax system are not particularly important, despite the significant increase in the ERT and in revenue. Figure 4.4 shows this clearly. It is only at the extremes that we find changes worth noticing, as the rest of the effective rates practically do not move.

When we compare the effective rates in brackets 2 to 10 in table 4.1, that is, the rates considering incomes of cumulative and non-cumulative type, to the rates obtained in this simulation, we observe a substantial decrease. These groups were subject to a flat rate on non-cumulative income

TABLE 4.6

ACCUMULATING TAXABLE INCOME[a]

(Taxpayers and Percentages)

Taxable Income Bracket (1)	Number of Taxable Units (2)	Effective Rates of Taxation: Reference (3)	Effective Rates of Taxation: Simulation (4)	Weighted Marginal Tax Rates (5)	Tax Revenue Share (6)
1	0	0.0	0.0	0.0	0.0
2	247540	0.705	0.784	1.580	0.007
3	244456	0.792	0.928	1.690	0.010
4	97441	1.012	1.017	1.780	0.005
5	173134	1.121	1.107	1.910	0.010
6	133451	1.214	1.211	2.190	0.010
7	596600	1.497	1.528	2.640	0.071
8	194498	2.026	1.982	3.930	0.041
9	77866	2.578	2.578	5.360	0.028
10	718761	2.855	2.864	8.940	0.441
11	2062216	4.360	4.368	12.910	2.413
12	1391454	6.029	6.043	16.530	2.869
13	830866	7.516	7.528	17.050	2.551
14	644462	8.475	8.484	72.220	2.632
15	592269	9.510	9.513	18.150	2.153
16	329276	10.339	10.355	19.500	2.159
17	179915	11.105	11.120	20.810	1.384
18	492254	12.149	21.169	22.900	4.804
19	273977	13.854	13.836	25.460	3.684
20	228058	15.555	15.539	26.900	4.158
21	133547	17.425	17.431	29.870	3.265
22	145088	19.594	19.630	34.450	4.828
23	83296	22.058	21.986	39.900	3.924
24	52692	25.304	25.320	43.100	3.444
25	22639	26.753	26.935	46.500	1.825
26	18187	30.579	30.596	48.300	1.852
27	41276	46.753	49.336	50.000	50.432
TOTAL	10005216	12.85	18.38	-	151548.3[b]

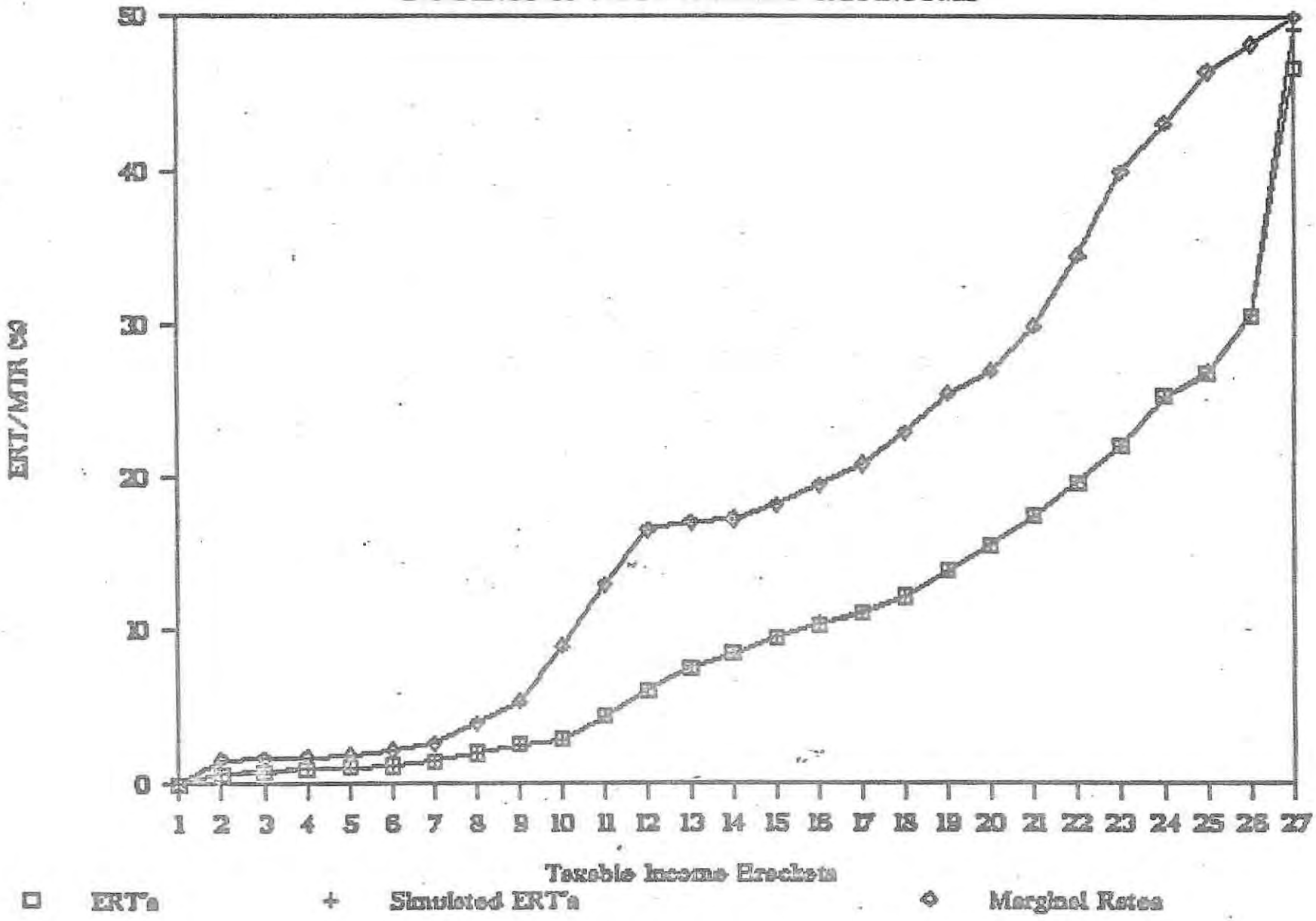
Source: Own calculations

a) Expanded Sample. All results apart from column (3) refer to the simulation

b) Millions of 1977 pesos

Figure 4.4

INCIDENCE OF ACCUMULATING TAX INCOME



in the base year of 5%, which gave rise to effective rates of around 3.5% in average. After accumulating income into one taxable base, subject to the (legal) marginal tax rates regime, these taxpayers were taxed according to rates below 5%, inducing much smaller effective rates, a point which explains the results.

A similar argument, but reversed, explains the increases in effective rates at the other end of the tax schedule, groups 19 to 26, and, in particular group 27 which shows an increase of 5.5% in its rate. For these groups, income globalization means an extended taxable base and a change of tax bracket to a higher one, where the marginal rate is superior. Needless to say, tax payments also increase for such taxpayers.

It can be seen that accumulating taxable income hits basically the extreme income groups, affecting the middle brackets only slightly. In this exercise, practically all of the adjustment is borne by groups 2 to 9 and 27. The former have a drastic reduction in effective rates and revenue, while the opposite is true for the latter.

This is due to the composition of income of such groups. In particular, we find in the top income bracket most individuals with earnings from dividends and interest payments, the two main components of noncumulative income in the year of study. For this group, the reform simulated has an important effect because its taxable base is increased substantially when noncumulative income becomes part of it.

A similar phenomenon explains why the middle groups are practically not affected by the reform. These groups obtain their income from essentially one source of cumulative type (wages and salaries), so when the policy is implemented,

they are not affected, unless in the composition of income for the individual cases, there are one or more sources of the noncumulative type.

There is, then, an inverse relationship between income composition and the effectiveness of the policy. The reform will be more effective, the more diversified the sources of income are, and less effective as taxable income comes from only one source of cumulative income or of noncumulative low level income. The rule for implementing this policy could be, tax those individuals with highly diversified high levels of income.

This policy induces two important effects on taxpayers firstly, the number of taxpayers subject to the cumulative income tax regime increases, since all taxpayers which were subject to other regimes, now enter this one. The increase is 15%, or 1291099 taxable units[14]. Secondly, there are some interbracket movements of taxpayers. Table 4.7 shows this. Column (4) is the number of taxpayers which changed bracket, or entered the universe, due to the simulated income globalisation. A minus sign indicates a reduction in the number of taxable units in that bracket; a plus, an increase.

The net effect of new taxpayers entering the schedule in this simulation can be seen in column (6) where its total is the new addition. Note also that the total in column (3) is that of taxpayers in the year of reference while the total in column (2) is the subset of taxpayers subject to the cumulative income tax regime, in the same year.

---

14. This effect does not mean that the universe of taxpayers increased. What it means is that the subset of taxpayers subject to the cumulative income regime increased to the size of the universe, and that all other taxation regimes desappeared.

TABLE 4.7

SIMULATION 1: INTERBRACKET MOVEMENTS INDUCED BY TAX INCOME ACCUMULATION

Taxable Income Bracket (1)	Number of original (2)	Taxpayers simulation 1 (3)	Difference (4)=(3)-(2)	Percent Difference (5)	Algebraic Sum of Differences (6)
1	0	0	0	0.0	0
2	69603	247540	+177937	2.56	177937
3	50528	244456	+193928	3.83	371865
4	44266	97441	+ 53175	1.20	425040
5	25086	173134	+148048	5.90	573088
6	41486	133451	+ 91965	2.21	665053
7	133700	596600	+462900	3.46	1127953
8	114181	194498	+ 80317	0.70	1208270
9	67442	77866	+ 10424	0.15	1218694
10	713765	718761	+ 4996	0.007	1223690
11	2056754	2062216	+ 5462	0.003	1229152
12	1375826	1391454	+ 15628	0.011	1244780
13	816265	830866	+ 14601	0.018	1259381
14	644836	644462	- 374	-0.0006	1259007
15	588857	592269	- 3412	0.006	1262419
16	321867	329276	+ 7409	0.023	1269828
17	177545	179915	+ 2370	0.013	1272198
18	482728	492254	+ 9526	0.02	1281724
19	275236	273977	- 1259	-0.005	1280465
20	231160	228058	- 3102	-0.013	1277363
21	137185	133547	- 3638	-0.03	1273725
22	140857	145088	+ 4231	0.03	1277956
23	85810	83296	- 2514	-0.03	1275442
24	49033	52692	+ 3659	0.07	1279101
25	22819	22639	- 180	-0.008	1278921
26	15547	18187	+ 2640	0.17	1281561
27	31738	41276	+ 9538	0.30	1291099
TOTAL	8714121	10005216	1291099	-	1291099

SOURCE: Own Calculations

a) The difference between columns (3) and (2) is not exactly equal to the total in column (6) due to rounding errors.

The interbracket movements are obscured by the increase in taxpayers at almost all levels. However, taking, for example, brackets 19, 20, 21, 23 and 25, it can be seen that they "loose" 10963 taxpayers in this reform. These taxpayers move to brackets 22, 24 26 and 27, with higher effective rates of taxation and revenue shares.

In general, this reform induces a greater progressivity of the tax system, a fact reflected in the higher rates found, although marginally for some groups. Those taxpayers in groups 2 to 9 who were taxed before the reform at a flat rate of 5% and are now taxed with a rate lower than that, can be considered as "gainers", since they are paying less taxes than before, but those who moved to higher brackets can be considered as "losers" since they pay more than their counterparts which remained in the same bracket. Note also, that some taxpayers remained in the same bracket. This is because they were, either neutral to the reform, or the increase in taxable income obtained through accumulation is not high enough to make people move more than one bracket upwards. Moreover, some cases were detected in which a taxpayer moved several brackets upwards, illustrating the importance that income accumulation can have on taxpayers whose income sources are fairly diversified.

It is clear that changing the regime of flat rates to one based on the marginal tax schedule, will have a negative effect on revenue and the ERT's for low income earners, at least as long as the accumulated taxable income falls in a bracket with a marginal rate inferior to the minimum flat rate prevailing at the time of the reform, in our example 5%.

This indicates the need for a rather discriminatory policy of income accumulation, depending on the type, source, and level of income.

This discussion reinforces the conclusion that a sound policy of expanding the taxable base by accumulating income of different types, should take into consideration the structure (or composition) of income of the taxpayers meant to be affected by the reform. Lack of this information would not only reduce the effectiveness of the measure but could also affect the welfare situation of some parts of society by taxing the wrong individuals.

4.2.2. Simulation 2: A Revenue-Neutral Tax Reform.

The decomposition of the tax schedule derived in section 4.1.2 can be used not only as a descriptive tool of the tax system but also to answer a diversity of questions quickly. The questions fall in two broad categories: In the first category, total tax payments, T, is considered an endogenous variable, and in the second one an exogenous, fixed, variable. The first type of questions deal with the effect of changes in the magnitude (width) of the tax brackets and/or of the taxable base, on total payments, and can be represented by $\partial T / Y_t = m_t$ The extent of the changes in T is given by the marginal tax rate. The other two parameters that can be varied inducing changes on T, are the marginal rates themselves and the fixed quotas, ie, $\partial T / m_t$ and $\partial T / \partial f^1$. Changing more than one parameter at a time is also possible to simulate.

In the second type of questions, a given level of tax revenue, T, is specified, and the variables Y_t, m_t and f^1 are endogenized until the solution is reached. For instance, the government may set a determined level of revenue as the goal of a fiscal policy and find the marginal rates which would be needed to achieve it, assuming no change in the width of the tax brackets. Or it might plan to increase the width of the brackets in order to broaden the taxable base and capture more taxpayers, until a point where the increase in revenue set would still be met, but this time without an increase, maybe even a decrease, of the marginal rates. In both cases, the answers would be easily found by means the decomposition of the schedule.

In the simulation that follows, we present an application of the decomposition of the tax schedule to a problem which is a mixture of the two types just mentioned.

In 1983 and again in 1986, the tax schedule in the Income Tax Law was modified in order to impose a surcharge of 10% to those individuals whose income level was equal to or above the equivalent of five legal minimum salaries. The idea behind this reform was to increase revenue by taxing more those with a higher ability to pay. Although the general qualitative effects were known before the reform was actually operative, the consequences on the effective rates of taxation were unknown and so, the full magnitude of the adjustment could not be assessed. In the same way, neither the effects on tax revenue, nor those on incidence were known.

Suppose, that an increase of 10% in the rates of groups 19 to 27 is going to take place as suggested above, but that this time the fiscal authorities are not interested in raising revenue, but in redistributing income from the top

to the bottom income earners. With this, they aim at diminishing the progressivity of the system at low income levels while increasing it at the higher ones. So, they decide to offset the increase in revenue arising from the imposition of the 10% surcharge, by lowering the marginal rates of groups 10 to 13, in such a way as to leave T unchanged. This is a typical problem in which T is set exogenously, m_t for the top groups is exogenous too, but the adjusting variable, m_t for the lower groups, is endogenized in order to leave T unaltered, an so keep the assumption of a revenue neutral reform[15].

Table 4.8 shows the results. The calculations in the upper panel are those corresponding to the groups to which the surcharge of 10% was applied. This rate can be seen in column (4). Column (6) is the marginal increase in revenue obtained by means of column (6) in table 4.5. Since the reform does not affect all taxpayers in the population, only those in groups 19 to 27, the change in revenue due to the groups affected is obtained by applying the surcharge to the total incomes in each bracket. This also helps to clarify the meaning of "total incomes in each bracket", as the amount of income of all taxpayers in the economy which are taxed according to the marginal rate of m_t, according to equation (4.2).

The lower part of table 4.8 is the adjustment made to the rates of the low-income groups. The new rates were found by substracting to the initial rates a factor obtained as a function of the (known) exogenous increase in revenue and the sum of total incomes for those groups. Since the adjustment is not linear, we eliminated the differences with an iterative technique. As we can see, the reduction needed in the marginal

15. While the choice of the tax brackets to which the 10% surcharge is applied is not arbitrary, the choice of groups 10 to 13, is. However, this illustrates clearly the uses of the decomposition.

rates is quite high, ranging from 10.9% to 20.8. The same percentage reductions apply to the levels of revenue, since, by assumption, the width of the brackets and the level of the taxable bases were kept constant.

In terms of revenue redistribution, the results are quite striking. The gainers in this case are the 4962610 taxpayers in brackets 10 to 13, 56.9% of the population, and the losers, the 989385 (11.4%) individuals in the top nine income brackets. If such a reform could be actually implemented, it would certainly have important redistributive effects, without harming the treasury.

TABLE 4.8

A REVENUE-NEUTRAL TAX REFORM

(Thousands of 1977 pesos)

Bracket Nr. (1)	H_t (Taxpayers) (2)	m_t^o (Legal) (3)	m_t^1 (Adjusted) (4)	ΔT & Δm_t % (5)	ΔT^a (10^3 pesos) (6)
19	275236	.2546	.2801	10	493644.6
20	231160	.2690	.2959	10	462307.6
21	137185	.2987	.3286	10	372078.3
22	140857	.3445	.3790	10	551876.0
23	85810	.3990	.4389	10	367187.8
24	49033	.4310	.4741	10	248830.0
25	22819	.4650	.5115	10	159173.2
26	15547	.4830	.5313	10	143706.7
27	31738	.50	.55	10	527371.2
TOTAL 19-27	989385 (11.4%)	-	-	-	3326175.4 (3.92%)[b]
10	713765	.0894	.0708	-20.8	700189.4
11	2056754	.1291	.1105	-14.4	1156009.6
12	1375826	.1653	.1467	-11.3	835903.0
13	816265	.1705	.1519	-10.9	634073.4
TOTAL 10-13	4962610 (56.9%)	-	-	-	3326175.4 (-3.92%)[b]
TOTAL CHANGE IN TAX REVENUE IN THIS SIMULATION					0

Source: Own calculations

a) Marginal increases/decreases

b) Percentages with respect to total marginal values (85073992 - 294101.6 = 84779890.4)

5. CONCLUSIONS

There are two main types of conclusions arising from this study. The first one is of statistical nature, and the second one deals with the economic policy issues derived from the simulations. On the statistical side, the obvious conclusion is the urgent need for an income tax data file which could be used by both, researchers and policy-makers. This file is non-existent, and its posible uses were clearly pointed out in this work. The file should be based in a regular survey and should be part of the national information system which already exists. Although data can always be "made up" using secondary sources of information, the findings (for the researcher) or the decisions (for the policy-maker) taken are only a rough approximation of what is really going on, and, in some cases there is even a risk of making wrong decisions or conclusions because of the quality of the data.

In Mexico thère has been over the years a constant concern to undertake regularly income and expenditure surveys. Although they are far from being standardized and systematized, they provide a solid basis for research and policy-making. On the fiscal side, however, there is nothing of the sort since most of these surveys have left out the tax variables. In fact, the only available fiscal information is that in the "Cuenta de la Hacienda Pûblica Federal" and that in "Indicadores Tributarios", both published by the Ministry of Finance, at high levels of aggregation[16].

---

16. See the references under "Secretaría de Hacienda..." at the end of the paper.

As has been pointed out, the 1977 income survey is mainly a wages and salaries survey, and, consequently, the results obtained apply basically to that type of income. Capital income, ie, variables in groups 12 and 13 in table A.1 are, on the one hand, poorly represented in the sample and, on the other, grossed up in a rather unsatisfactory way, not allowing us to perform realiable simulations on capital income and/or draw sound conclusions.

With respect to the economic-policy conclusions, the most striking one is the structural regidities shown by the Mexican income tax system vis à vis the simulated changes. Although in some cases the effective rates showed a significant increase, the overall efect on the incidence of the system was unimportant.

In particular, turning to the simulation concerning the degree of accumulation of the taxable base, the main lesson to be drawn is that the effectiveness of the reform depends on the level and composition of taxable income. The higher and more diversified income is, the higher the level of revenue raised. It was with this simulation that the importance of the structure of taxable income for the effectiveness of a reform became more apparent. Clearly, tax reforms must take into consideration the type of taxpayers they are designed to affect, and so, they must be discriminating in order to maximise efficiency.

The simulation just discussed touched upon aspects of efficiency, in the sense that it would affect the economic decisions of the agents involved. Raising the level of taxation might, for example, induce some people to work less, or in the margin, to refuse accepting a job. These are aspects which were not studied in this paper, but which are crucial to be taken into account when designing a fiscal reform, thus complementing the discriminatory aspects mentioned above.

The revenue-neutral tax reform simulation dealt with another aspect of fiscal policy, that of redistribution. It was fairly clear how, without modyfing a pre-specified level of tax revenue, the government could improve the distribution of income by taxing the top income groups more and redistributing that revenue to the lower income groups, via a reduction in the marginal rates. The results showed that 57% of the individuals would be "gainers", while only 11% would be "losers".

The previous simulation was carried out by means of a reinterpretation of the income tax schedule. It was shown that we can very easily answer questions in which the level of revenue is either exogenous or endogenous and that a broad spectrum of simulations can be performed quickly by just varying the relevant parameter in the decomposition. Further refinements of the data base and more precise and detailed interpretation of the ITL, would permit more accuracy and reliability in the results obtained with such an approach, which would then be of great help in the design and implementation of fiscal policy.

The exercises performed in this work do not necessarily mean that fiscal, or for that matter, economic policy, should only be based on mathematical or numerical models, but this is the best alternative we have so far in order to simulate different scenarios with their corresponding outcomes, and so, to try to minimize the risk of error associated to any decision.

REFERENCES

AARON, H.J., and J.A. PECHMAN, eds. (1982). How Taxes Affect Economic Behavior. Studies of Gvnmt. Finance. Washington: The Brookings Institution.

ALTIMIR, O. (1982). "La Distribución del Ingreso en México 1950-1977", in B. de M. (1982).

ASPE, P., and P. SIGMUND. (1985). The Political Economy of Income Distribution in Mexico. Holmes and Meier: N.Y. and London.

ATKINSON, A.B., M.A. KING, and H. SUTHERLAND. (1983) "The Analysis of Taxation". SSRC Programme on Taxation, Incentives and the Distribution of Income. Discussion Paper No. 51, October.

_____, and J.E. STIGLITZ. (1980). Lectures on Public Economics. London: McGraw-Hill.

_____, and SUTHERLAND. (1984). TAXMOD, Users' Manuel London: L.S.E.

BAILLET, Alvaro. (1986), "MASTERF: A Data File for Tax Microsimulations". México, D.F. Mimeo

BANCO de MEXICO, S. A. (1982). Distribución del Ingreso en México. 3 volúmenes. Mexico City: B. de M.

_____(1986). Informe Anual 1985. Mexico City: B. de M.

DIEZ-CANEDO, J., and G. VERA (1982), "La segmentación del mercado de trabajo y el nivel de ingresos", in B. de M. (1982).

DOMINGUEZ, M.E., and CALVO N.E. (1978). Estudio del Impuesto sobre la Renta para 1978 (tres volúmenes). México City: Docal Editores, Mayo.

FEENBERG, D.R., and H.S. ROSEN. (1983). "Alternative Tax Treatments of the Family: Simulation methodology and results", in feldstein (1983).

FELDSTEIN, Martin, ed. (1983). Behavioral Simulation Methods in Tax Policy Analysis. A. N.B.E.R. Project Report. Chicago and London: The University of Chicago Press.

_____, and D. FRISCH. (1977). "Corporate Tax Integration-estimated effects on capital accumulation". National Tax Journal, vol. 30, No. 1, January: 37-51

_____, and D.R. FEENBERG. (1983). "Alternative tax rules and personal saving incentives". Microeconomic data and Behavioral simulations", in Feldstein (1983).

GIL DIAZ, F. (1985). "The Incidence of Taxes in Mexico: A Before and After Comparison", in Aspe and Sigmund (1985).

HAUSMAN, J.A. (1981). "Labor Supply", in Aaron and Pechman (1981)

KING, M.A. (1983). "Welfare Analysis of Tax Reforms Using Household Data", Journal of Public Economic, vol. 21.

King, M.A., and FULLERTON. (1984). The taxation of Income from Capital. Chicago and London: Chicago University Press for the N.B.E.R.

_____, and RAMSAY, P. (1983). TRAP. Tax Reform Analysis Package", SSRC Programme Discussion Paper 35.

LINDSEY, L.B. (1983). "Alternatives to the current maximum tax on earned income", In Feldstein (1983)

MUSGRAVE, R.E., et. al. (1974). "The Distribution of Fiscal Burdens and Benefits". Public Finance Quarterly, 2, pp. 259-311.

_____, (1959). The Theory of Public Finance. New York: McGraw-Hill.

_____, and P. MUSGRAVE. (1980). Public Finance in Theory and Practice, 3rd. ed. New York: McGraw-Hill.

PECHMAN, J.A., and B.A. OKNER. (1974). Who Bears the Tax Burden?. Studies in Government Finance. Washington, D.C.: The Brookings Institution.

PIGGOTT, J., and J. WHALLEY, eds. (1985). New Developments in Applied General Equilibrium Analysis. New York: C.U.P.

REYES HEROLES, J. (1976). Política Fiscal y Redistribución del Ingreso. Unpublished B.A. Thesis. México: ITAM.

SECRETARIA DE HACIENDA Y CREDITO PUBLICO. (1977). Ley del Impuesto sobre la renta, 1977. México: SHCP.

_____(1978). Indicadores Tributarios, 1977. México D. F. : S.H.C.P.

_____(1978a). Cuenta de la Hacienda Pública Federal, 1977. México D. F. : S.H.C.P.

SECRETARIA DE PROGRAMACION Y PRESUPUESTO. (1977). Encuesta Nacional de Ingresos y Gastos de los Hogares. Primera Observación. México: SPP.

_____(1982). Sistema de Cuentas Nacionales, 1977-1982. Mexico City: S.P.P.

_____(1977a). Resumen Metodológico ENIG77. México: SPP.

_____(1985). Estadísticas Históricas de México. 2 vols. México, D. F.: S.P.P.

SHOVEN, J.B. and WHALLEY, J. (1984). "Applied General Equilibrium Models of Taxation and International Trade: An Introduction and Survey". Journal of Economic Literature, vol. XXII, September: 10007-1051.

_____, and, _____. (1972). "A General Equilibrium Calculation of the effects of differential taxation of income from capital in the U.S.". Journal of Public Economics, vol. 1, No. 3/4, 281-321.

SLEMROD, Joel. (1985). "A General Equilibrium Model of Taxation that Uses Micro-Unit Data: With An Application to the Impact of Instituting a Flat-Rate Income Tax", in Piggott and Whalley (1985).

VINCE, P. (1983). "Tax Credit-The Liberal Plan for Tax and Social Security", Women's Liberal Federation, London.

APPENDIX A

We present in this appendix the most important aspects of the numerical correction to the data in ENIG77. This is not a full account of the adjustment that was needed to create MASTERF. The complete details, assumptions and results can be found in Baillet (1986).

A.1 The 1977 Income and Expenditure Survey

ENIG77 is a national survey that was conducted in the months of August to October, 1977, to collect information for the first semester of that year. The sample size was 15360 households randomly chosen in 3 metropolitan areas and 8 geographical regions. The survey provides detailed information of individuals as well as households on current income, current expenditure and on sociodemographic factors. The ENIG77 is the most recent available survey of this kind in Mexico.

As with all surveys, ENIG77 has a number of shortcomings which can be grouped into two categories: i) sampling errors and ii) conceptual limitations. The most important for our purpose are:

a) The degree of income underreporting is quite high when compared to national accounts figures. Without entering here into the statistical and conceptual problems involved in such a comparison, it is important to acknowledge this fact for tax analysis, as the difference creates distortions.

b) Information on taxes and other income deductions paid by the household and by the individuals is not available. Information on social security payments and transfers is not available either. Income is reported net of these concepts.

c) Limitations due to the degree of non-response as well as to incomplete and unprecise answers. The exact size of this error is not known.

d) The geographical coverage of the survey is not representative of the rural/urban areas. Characteristics at the municipal level were also lost because of this.

e) The questionnaire is biased towards capturing urban information, leving aside variable representative of the rural areas.

Because of these problems, particularly b), the data had to be adjusted as discussed in the main text.

A.2 Income Categories and Underreporting in the 1977 Survey.

Table A.1 Shows the structure of income as reported in the survey. Disposable current monetary income (1), is defined as total income received by individuals in the household, less direct taxes, social security and housing benefits contributions, and union fees. This definition does not include imputed income in any form. Total income is subdivided into a total of twenty one categories; we omit their definitions here and refer the reader to S.P.P. (1977a).

Table A.1

STRUCTURE OF INCOME IN ENIG77

1. Current Monetary Income

11. Work Remunerations

111. Wages, salaries, overtime and compensations
112. Year-end bonus
113. Vacation bonus
114. Profit-sharing to workers (reparto de utilidades)

12. Entrepreneurial Income

121. Remunerations from professional services
122. Income from the ownership of business
123. Income from "house industries" (industrias caseras)
124. Other entrepreneurial Income

13. Property Income

131. Rents (Land and real estate)
132. Interest Income
133. Othe property income (dividends and royalties)

14. Other Income

141. Income from the sale of personal property

15. Transfers Received by Households

151. Pecuniary gifts
152. Income from pensions and retirement allowances
153. Other transfers

A.2.1 A Note on ENIG77's Underreporting.

It is well known that income surveys underestimate the actual values of the reported variables, specially at high income levels. Although S.P.P. (1977, p. 7), reports a non-response factor of the order of 7.3%, and an underestimation of the total population of around 5% with respect to the forecasted figures of the statistical bureau, nothing is mentioned with respect to the differences between income obtained in the survey and the corresponding figures in the national accounts, as an indication of the degree of income underreporting[1].

Altimir (1982) carried out calculations to determine the size of such underreporting, working with income concepts akin to those in ENIG77, which he calculated from the national accounts. Table A.2 shows his findings.

TABLE A.2

DEGREE OF UNDERREPORTING IN ENIG77 BY INCOME TYPES

(Percentages with respect to mean household incomes in the national accounts)

Type of Income	Percentage of discrepancy from the national accounts
Wages & Salaries	-17
Agriculatural	- 4
Non-Agricultural	-18
Entrepreneurial Income	-66
Agricultural	-55
Non-Agricultural	-69
Property Income	-53
In cash	-83
Transfers	-16
Disposable Income of Households	-39

Source: Table 9, Altimir (1982), p. 143.

1. See S.P.P. (1982) for a full description of the Mexican System of National Accounts.

Although the original data could have been corrected for income underreporting, we preferred to leave them as such in order to capture the structural characteristics of income coming out of ENIG77, and the associated tax structure resulting from the grossing up, given the structure of income in the original survey.

In order to obtain an indication of the reliability of the tax figures originating from ENIG77, that is, of the tax collections implicit in the expanded sample, taking as reference actual income tax collections as reported by the Ministry of Finance, we defined the following compliance and associated evasion coefficients:

$$CC_i = \frac{RSHCP_i}{R_i} \qquad (A.1)$$

$$EC_i = 1 - CC_i \qquad (A.2)$$

$$i = 1,2,3$$

$RSHCP_i$ is actual tax revenue from income type i, and R_i is implicit tax revenue in the survey. As CC_i tends to one, R_i tends to $RSHCP_i$; EC_i is an indication of the degree of evasion. Table A.3 shows the results, grouping incomes into three types, ie, wages and salaries, professional income and capital income[2].

TABLE A.3

TAX LEVELS AND ASSOCIATED COEFFICIENTS

(Millions of pesos and Proportions)

Variable	Ministry of Finance Figures	Expanded ENIG77	Compliance Coefficient	Evasion Coefficient
Tax Revenue from Wages and salaries	35384.0	47973.8	0.738	0.262
Tax Revenue from Professional Income	2234.4	14.1	158.5	-157.5
Tax Revenue from Capital Income	8512.6	90123.8	0.094	0.906
Total Tax Revenue	46131.0	138111.7	0.334	0.666

Source: Own calculations

As can be seen the only evasion coefficients which are "reasonable" are those for wages and salaries and for total tax revenue. The coefficients for professional income and for capital income reflect, respectively, an important degree of underreporting in the survey and a high level of evasion[3].

2. The actual revenue figures are those reported in SHCP (1978), Indicadores Tributarios. Lack of more detailed data in the Ministry of Finance statistics, prevented the calculation of evasion coefficients at a more disaggregated level.

3. In the case of professional income, for example, the number of cases surveyed was only 66, with a net annual mean income of 9144 pesos, against a legal minimum of 28970 pesos.

Since income underreporting amounts to tax underreporting, it could be argued that the evasion coefficients found are overestimated. As often happens in applied work, a trade-off is established between ideal and actual data needs. Correcting the data for underreporting would have amounted to modifying the structural characteristics of the survey, in order to obtain higher income and tax revenue figures. Working with the original data respects the structure, but carries over to the calculations a certain degree of inaccuracy. Unfortunately, we have no other sources of information to corroborate or invalidate these presumptions.

A.3 Assumptions and Techniques for Grossing Up Income.

The calculation of the final data in MASTERF involved the grossing up of net income data reported in ENIG77 and the calculation of base year tax variables. Table A.4 shows the annualisation factors for every income category as well as the assumptions needed for the grossing up. The annualisation factors for most types of income are based on monthly income series taken from sources such as "Estadística Industrial Mensual" and "Indicadores Tributarios", published by the Ministries of Budgeting and of Finance. In other cases, where income is received only once a year or on a regular monthly basis, the factors used were 1 or 2. More details can be found in Gil Diaz (1985), pp. 83-84. The numerical techniques used are as follows (numbers refer to tables A.1 and A.4).

i) Work Remunerations, 11.

The procedure described here applies to the whole of group 11, to item 152, retirement income and, with a small modification, to professional income, 121. In order to obtain gross income from net income we devised a numerical technique based on an iterative program, since, analytically, it is not possible to derive an expression to calculate it. This program works applying the following equations, which can be seen as a formalization of parts of the ITL. Note that all calculations are performed on an annual basis.

$$\bar{Y}^h_{11} = NY^h_{11} + TAC^h_{11} + SS^h_{11} \qquad (A.3)$$

$$BG^h_{11} = \bar{Y}^h_{11}(1-0.2) = 0.8\,\bar{Y}^h_{11} \qquad (A.4)$$

$$TAC^h_{11} = f_t + m_t\,(BG^h_{11} - \bar{Y}_t) \qquad (A.5)$$

$$SS^h_{11} = s\,\bar{Y}^h_{11} \qquad (A.6)$$

where:

t = 1,...T. Income brackets in the schedule

$\bar{Y}^h_{11}$ Total gross income from work remunerations

NY^h_{11} Net income

TAC^h_{11} Tax payments from work remunerations

s rate of social security contributions

SS^h_{11} Social security contributions

BG^h_{11} Taxable base

f_t Fixed tax payments on lower income limit, t

m_t Marginal legal tax rate in bracket t

$\bar{Y}_t$ Lower income limit in bracket t

The sequence of calculations performed by the program corresponds to equations (A.4) to (A.6), and is equivalent to solving equation (A.3) in implicit form, until its value is zero:

$$\bar{Y}^h_{11} - NY^h_{11} - TAC^h_{11} - SS^h_{11} = 0 \qquad (A.7)$$

ii) Entrepreneurial Income, 12.

Professional income, 121. To gross up this category we have to assume that a certain percentage of the gross income earned by the individual is made-up of professional expenditures, which are tax-deductible. We assume here that-

the figure is 60% and use the algorithm to calculate a taxable base that would allow us to find the corresponding gross income according to equation (A.3) and:

$$BG^{h}_{21} = NY^{h}_{21} + TAC^{h}_{21} \qquad (A.8)$$

or

$$BG^{h}_{21} - NY^{h}_{21} - TAC^{h}_{21} = 0 \qquad (A.9)$$

Gross income is obtained as,

$$Y^{h}_{21} = \frac{BG^{h}_{21}}{1-0.6} \qquad (A.10)$$

Note that in this case the algorithm works on the taxable base, not on gross income as previously, and that the latter is obtained by "reflating" the former by 60%, the amount of deductions that were supposedly made to the initially unknown gross income.

Income from enterprises, 122. This type of income accrues to the household in two forms, profits and dividends, and is one of the most problematic areas to deal with. We shall discuss in this and the next paragraphs the way in which we grossed up profits, closely following the study by Gil Diaz mentioned before. In order to understand the details of the calculations we have to discuss first some aspects of the ITL.

The Income Tax Law distinguishes between major and minor taxpayers (causante mayores y menores) according to their yearly gross income (1977). If it is less than or equal to -

1,500,000 pesos, they are classified as minor taxpayers; enterprises whose income is more than 1,500,000 pesos a year are major taxpayers.

The first step is to decide which firms are major taxpayers and which minor taxpayers. For this, a further assumption has to be made, namely, that the profit margin on sales is 10%, so that, eg, 150,000 pesos of annualised net income (profits) correspond to 1,500,000 pesos of gross income, therefore defining major/minor taxpayers. Although we keep the assumption of 10% profit margin as in Gil Diaz, we differ from that study in determining the limit for major/minor taxpayers, and follow what the law stipulates[4].

There are, then, two situations which arise: i) profits from minor taxpayers and ii) profits from major taxpayers. We shall deal with them sequentially.

i) In the case of minor taxpayers the grossing up is made taking into account the average tax rate for such firms prevailing in 1977, ie, 5%. The factor is 1.0526 = 1/(1 -.05), which, when multiplied by net income of minor taxpayers, gives taxable (gross) income.

ii) Major taxpayers are dealt with in the following way: Define taxable income,

$$TI = \text{After Tax Income}/(1 - .40 - .8) \qquad (A.11)$$

---

4. The limit set by Gil Diaz is 300,000 pesos of net income, resulting in 3,000,000 pesos of gross income. Arguing tax evasion, he defines major/minor taxpayers as those with gross income of more/less than 3 millions

where the tax rates of 40% and 8% are the average corporation income tax in 1977 and the profit-sharing rate to workers, respectively. Assume that 50% of after tax income (ATI) is reinvested, and that the other half constitutes a "salary" that appears in the survey under concept 122, income from enterprises. This is called by Gil Diaz "disposable income from business" (DIFB). To arrive at the figure for taxable income (TII) of the individual we then have[5]:

$$TII = DIFB/0.52 \qquad (A.12)$$

since $TI = (DIFB \times 2)/.52$

As can be seen, this amounts to deriving a grossing up factor of 3.846 which is multiplied by net income from own enterprises (DIFB) as appears in ENIG77, to obtain taxable income of the firm. Since we are dealing with individuals, we take 50% of TI as taxable income, TII, and add it to their taxable base.

Income from small family industries, 123, This type of income is grossed up considering these enterprises as minor taxpayers, in spite of the high level of evasion detected among them and of the difficulties involved in tracking down these agents. The income in the survey is just multiplied by 1.0526.

---

5. The concept of taxable income is not the same as that of gross income. The latter includes the operational costs whereas the former does not.

Other entrepreneurial income, 124. This category is formed by two items, rents of houses and buildings, 124 (1), and income from boarding and lodging, 124 (2)[6]. Due to high evasion and/or avoidance of taxes detected among these units, as well as to the strong possibility of these agents reporting income gross of taxes, eg, due to lack of control from the authorities on taxes paid, we considered these items as needing no further adjustment, apart from annualisation.

iii) Property Income, 13.

Rents of land and real estate, 131. For the same reasons explained above, this item was considered gross of taxes.

Interest Income, 132. This is grossed up by applying a factor which is 1/(1 - .1739) = 1.2106. The figure 0.1739 is the average tax rate on interest in 1977.

Other property Income, 133. It is composed by two items which are, 133 (1), dividends, and 133 (2), patents and author rights. The latter is tax-exempt, so we concentrate on the former.

Dividends is the most problematic item to deal with when trying to obtain enterprise income. The idea is to impute the income (profits) that gave rise to the dividends in the survey to the corresponding individuals. In other words, the suggested method tries to answer the question, --

---

6. Refers mainly to catering services in guest houses and family business .

what is the equivalence, in terms of gross income of the enterprise, of the amount of dividends reported at the individual level in ENIG77?. Once this has been found it has to be imputed to the individual, therefore forming part of its income. To see how the method works, let P be gross corporation profits, and P(1 - t - 0.08) be disposable profits once the average corporation income tax in 1977, t, (40%), and the profit sharing rate to workers (8%) have been deducted. Net profits can be distributed to shareholders in whatever proportion the board of directors decide, and/or re-invested. The former are the dividends, while the latter are firms' savings. In Mexico, the proportion that is distributed among shareholders pays a tax of 21%, ie, P(1 - t - .08) (r) (1 - .21) = D, where r is the dividends/profits ratio. This rate can be determined empirically, using data on dividends tax and on corporate income tax, or it can be found residually if the ratio P/D is known. This gives the formula to calculate the grossing up factor for dividends:

$$P/D = 1/(1 - t - .8)\ (r)\ \ (1 - .21) = 111.41 \quad (A.13)$$

Since P/D in the aggregate is known, r is found to be equal to .02185. From the ratio of taxable profits (income) to net income from dividends, P/D, we obtain gross corporation profits, P = 111.41 D. It should be noted that dividends are only 0.219% of total income in the survey.

The fourth of equations (3.5) deals with tax payments from dividends. Tax payments on dividends are calculated by firts multiplying the average tax rate on profits in 1977, 40%, and the gross income obtained previously. Now, since dividends reported in the survey are net of taxes, and the law stipulates that a further 21% must be paid on gross distributed dividends, we have to perform a grossing up of net

dividends before multiplying them by 21%. The second term on the right hand side of equation (3.5) shows these calculations. The grossing up factor, 1.27 is obtained as 1/(1-0.21). Note that we are in fact dealing with two types of income in the case of dividends. The first type is gross corporation profits imputed to the individual through the technique discussed before. On these, 40% of taxes is paid. The second type is the distributed dividends, which, after being grossed up, are taxed 21%. Thus, net dividends allow us to find imputed gross corporation profits, gross dividends, and thereby total tax payments on dividends.

iv) Other Income, 14
Is not taken into account since it is tax neutral.

v) Transfers Received by families, 15.

Apart from item 152, income from pensions and retirement allowances, which is considered as part of group 11, all others are tax-exempt and therefore neutral. They were only annualised.

TABLE A.4

SUMMARY OF THE GROSSING UP METHODOLOGY

VARIABLE	DESCRIPTION	ANNUALISATION FACTOR[1]	GROSS UP METHOD	ACCUMULATIVE TAXABLE BASE	TAXABLE BASE[3]	TAX PAYMENTS	LEGAL MARGINAL TAX RATE	ERT[4]
111	Wages & Salaries[2]	2.169	Eq. (A.7)	YES	T.A.	Eq. (A.5)	T.A.	YES
112	End-Year Bonus	2.169	Eq. (A.7)	YES	T.A.	Eq. (A.5)	T.A.	YES
113	Vacation Bonus	2.169	Eq. (A.7)	YES	T.A.	Eq. (A.5)	T.A.	YES
114	Profit-Sharing to work.	2.169	Eq. (A.7)	YES	T.A.	Eq. (A.5)	T.A.	YES
122	Business Income	2.0883	1.0526/See Text	Only Major Taxp.	See Text	Eq. (3.5)/(A.5)	T.A./5%	YES
123	House Industries Inc.	2.1306	1.0526	NO	Gross Income	Eq. (3.5)	5%	YES
121	Professional Income	1.919	Eq. (A.9)	YES	T.A.	Eq. (A.9)	T.A.	YES
124(2)	Boarding & Lodging	2.077	Taken as Gross	YES	Gross Income	Eq. (3.4)	T.A.	YES
124(1)	Rents of Houses	2.077	Taken as Gross	YES	Gross Income	Eq. (3.4)	T.A.	YES
131	Real Estate Rents	2.077	Taken as Gross	YES	Gross Income	Eq. (3.4)	T.A.	YES
132	Interest Income	2.1015	1.2106	NO	Gross Income	Eq. (3.5)	17.39%	YES
133(2)	Patents Income	0.75	NO[5]	NO	Neutral	NO	NO	NO
133(1)	Dividends	2.1015	See Text	NO	See Text	Eq. (3.5)	40%/21%	YES
153(2)	Insurance Income	2.0	NO	Exempt	Neutral	NO	NO	NO
153(3)	Non-Insurance Income	1.0	NO	Exempt	Neutral	NO	NO	NO
152	Income from Pensions	2.169	Eq. (A.7)	YES	T.A.	Eq. (A.5)	T.A.	YES
153(4)	Scholarships	2.0	NO	Exempt	Neutral	NO	NO	NO
153(5)	Indemnisations	1.0	NO	Exempt	Neutral	NO	NO	NO
153(1)	Divorce Pensions	1.0	NO	Exempt	Neutral	NO	NO	NO
151	Cash Gifts	1.0	NO	Exempt	Neutral	NO	NO	NO

NOTES:
1 Taken from Gil Diaz, (1985).
2 Variables 111 to 114 and 152 are grouped into a single item called Wages and Salaries.
3 T.A. Through Accumulation of the taxable base.
4 ERT. Effective tax Rate. See equation (3.1).

APPENDIX B

THE 1977 PERSONAL INCOME TAX SCHEDULE (Article 75)

(Pesos)

Bracket	Lower Limit		Upper Limit	Tax on Lower Limit	Rate of Tax on Excess
1	0.01	to	4,800.00		Exempt
2	4,800.01	"	5,760.00	33.75	1.58
3	5,760.01	"	6,720.00	48.90	1.69
4	6,720.01	"	7,680.00	65.10	1.78
5	7,680.01	"	8,640.00	82.20	1.91
6	8,640.01	"	9,600.00	100.53	2.19
7	9,600.01	"	14,400.00	121.55	2.64
8	14,400.01	"	19,200.00	248.25	3.93
9	19,200.01	"	24,000.00	436.90	5.36
10	24,000.01	"	28,800.00	694.15	8.94
11	28,800.01	"	38,400.00	1,123.25	12.91
12	38,400.01	"	48,000.00	2,362.60	16.53
13	48,000.01	"	57,600.00	3.949.50	17.95
14	57,600.01	"	67,200.00	5,586.30	17.22
15	67,200.01	"	76,800.00	7,239.40	18.15
16	76,800.01	"	86,400.00	8,981.80	19.50
17	86,400.01	"	96,000.00	10,853.80	20.81
18	96,000.01	"	120,000.00	12,851.56	22.90
19	120,000.01	"	144,000.00	18,347.56	25.46
20	144,000.01	"	174,000.00	24,457.96	26.90
21	174,000.01	"	204,000.00	32,527.96	29.87
22	204,000.01	"	264,000.00	41,488.96	34.45
23	264,000.01	"	324,000.00	62,158.96	39.90
24	324,000.01	"	384,000.00	86,098.96	43.10
25	384,000.01	"	444,000.00	111,953.96	46.50
26	444,000.01	"	524,000.00	139,853.96	48.30
27	524,000.01		and over	262,000.00	50.00